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THE LONG ISLAND CITY POWER STATION.

The magnificent generating station just erected and equipped at Long Island City by the Pennsylvania Railroad is the latest addition to the group of large power plants in New York city. This new plant is noteworthy for several reasons, the first being that it is intended primarily to furnish power for operating trains through the Pennsylvania tunnel, by means of which that road will enter the metropolis, which is one of the greatest undertakings that has ever been started by a railroad. It is a work requiring many years for its completion and involving the spending of many millions of dollars. It will give the Pennsylvania Railroad entrance to the city of New York and rail connection with Long Island and New England. The present power plant is but one of a pair which will furnish power for operating the trains in this tunnel. The other station will be erected in New Jersey.

Another feature of the station which is noteworthy is the use of steam turbines. This is not unusual in the modern electric generating station, though it is somewhat significant of the feeling on the part of leading engineers regarding this prime mover that it should be adopted as the motive power for one of the most important generating stations in the world.

As regards the station itself there is nothing particularly unusual. The boiler arrangement is different from that which a year or so ago it was thought would become standard. The importance of reliability in the modern generating station has led to the so-called unit system of arranging the apparatus; that is to say, to each prime mover is assigned a certain number of boilers, which, if need be, furnish the steam to that engine alone, though generally it is planned to operate the whole boiler system in parallel. Each engine also drives its own generator, so that the separate units of the station are kept isolated until they are brought together at the switchboard. Even here, if desired, one section of the distributing system can be assigned to any one of the generator units. With this unit arrangement, and on account of the small floor space required by the steam turbine, a plan was developed in which the boilers were arranged in rows running at right angles to the length of the boiler room, each row of boilers forming one battery for its corresponding turbine. In the Long Island power-house a different arrangement is employed. Here the boilers are placed on two floors, one above the other, those on each floor being arranged in two rows facing on the firing floor, the length of this floor being parallel to the engine room. This arrangement gives a short run of the steam piping and still enables the boilers to be grouped together in units, as desired. There are four of these units in the present station, each consisting of eight boilers. One unit supplies steam for the electric lighting generators and

the other three units for three steam turbines for railway service. Doubtless each of the two types of boiler room has its own advantages, one being more suitable for one site than another; but it is not yet certain that either of them can be called standard, for there are other arrangements which are made practical through the characteristics of the steam turbine.

One feature of the boiler-room equipment which is unusual is the provision of a small booster, the purpose of which is to set up counter electromotive forces in opposition to those developed by electrolysis in the condenser, or due to a drop of potential caused by the flow of stray currents which might try to find their way back to their source through the water pipes of the station. This small generator is driven by a motor and is connected to various points of the condenser and piping system, resistances being placed in the various leads so as to give control over the voltage impressed at each point. Another protection is the cutting of the water pipes before they enter the building to allow an insulating section to be inserted and the providing of a heavy copper by-pass conducting the currents which might enter the station through the pipes around the station to the water of the river. If, as seems to be indicated by the electrical survey which was made of the water pipes in the vicinity of the power-house, there be a return current flowing through them to the river, this shunt path, which consists of a heavy copper cable, will undoubtedly serve a useful purpose. As regards the condenser there would naturally be some corrosion due to the so-called galvanic action in addition to any electrolytic action caused by wandering currents. As the booster is connected by one pole to the cable which shunts the station and with the other pole through various leads to seven points on each condenser, careful adjustment is necessary to prevent galvanic action in the condenser. To do this without a flow of current one pole of the booster should be connected to the copper tubing in the condenser and the other to the iron. If the rheostats placed in these seven leads are to be effective in regulating the voltage at any point, it will be necessary that currents flow through these conductors; if currents flow through them these currents would themselves cause electrolysis unless they are prevented from leaving the piping at any point. The booster must, therefore, act to keep all points of the station water system at potentials so low that current is flowing in at all points.

The governing of the turbines in these stations is carried out on the plan originally proposed by Parsons; that is to say, steam is admitted into the turbine chamber in puffs and not in a continuous stream. Other turbine governors regulate either by throttling the steam or by opening or closing additional inlets, or by a combination of these methods. It is said that the Parsons method, which keeps the governor in constant motion, is particularly reliable because there is less opportunity for the governor to hitch. The oiling system in such a large station is naturally an important feature, and here the modern plan of circulating a large amount of oil through a very complete oil-pipe system has been adopted. It may, of course, be expected to give excellent results not only in preventing hot bearings, but in saving oil.

The equipment of this station is very complete throughout. A continuous source of excitation is provided by means of a storage battery, a practice which may be said to-day to have become standard for all important stations. The electrical control of apparatus is the most modern type, giving great facility in controlling the apparatus in the station itself, and the way in which the power is distributed, from the operator's board. Although the size of the units adopted for the plant—5,500 kilowatts—is not as great as that which has since been adopted for other stations, at the time the plans for this power station were drawn up it was the largest size which could be said to have been standardized. The ultimate equipment of the power-house, it is expected, will be fourteen of these turbines, giving a total output of about 105,000 horse-power.

THE TIME AND THE MEANS.

One of the interesting phases of the present situation in the electric light industry is the active campaign being carried on to secure new consumers. Many methods are being employed to attract the attention of new users of electricity for light and power. Many kinds of advertising are being tried. The daily press is being used to good effect, and circulars of all kinds are being distributed where they will do the most good.

The central stations are not alone in wishing to increase the use of electricity, for an association has been formed which hopes, by a united endeavor, to spread the use of electrical apparatus. In this way not only will the central stations benefit, but the manufacturers of all kinds of electrical appliances will share in the profits of an increased trade.

As far as the electric lamp is concerned, the only serious competitor is, of course, gas; and the increasing use of the incandescent mantle, as well as reductions in the price of gas, either voluntary or compulsory, are the greatest obstacles confronting the wider use of the electric lamp. Therefore, what the central stations need most is an effective weapon for meeting the attacks of the gas people, and even for invading the territory of the latter. In other words, the time is now ripe for the general introduction of the newer and more efficient types of incandescent lamp. There are several of these which have been brought to a practical stage. The only requirement is that the factories be able to put them out in sufficiently large quantities. With respect to the new carbon filament, this would not seem difficult to do, for while the general introduction of the metallized filament would certainly throw the old type of filament out of the market, the carbon lamp factories should be able, without much difficulty, to adapt themselves for turning out the new type of lamp; and since it would require some time to supply everybody with the lamp, the change could not be made in a day, and much of the old stock which is now on hand could be sold. The present certainly seems to be an opportune time for introducing this lamp, for the very fact that it is a new type of lamp would argue much in its favor with users of gas, and the central stations can be depended upon not to waste any of the advertising ammunition with which the lamp would furnish them.

ANOTHER DRAIN ON NIAGARA FALLS.

It is rather inopportune that just at the time when we in this country seem to have taken the first steps toward preserving Niagara falls, and have even made a move to secure the cooperation of the Dominion of Canada, plans should be proposed for the erection of another large power plant on the Canadian side. The general impression has been that the Dominion would look after her own interests in the falls, and the fact that Victoria park will receive a large rental from the plants in course of erection there has been cited to prove this. It seems, however, that the cities and towns located at a distance fifty miles or so from the falls are more interested in cheap power than in the preservation of the cataract. It may be that this attitude is assumed for its moral effect, but if one may judge from the report of a recent commission representing a number of towns in Ontario, an abstract of which will be found on another page of this issue, the commission itself and a number of the towns are in dead earnest.

The plans, in brief, contemplate constructing a hydraulic plant with an output possibly of 100,000 horse-power. This is to be transmitted to the various towns which enter into the arrangement and sold to them and to private consumers. The report of the commission recommends that the work be undertaken by the municipalities, a number of which signified their willingness to share in the expense before the report was made. It is hoped by the commission that a number of other towns would join with them, raising the total to fifteen or possibly eighteen.

The reasons given for this undertaking are the cheapening of power for all purposes. It seems that the towns wish to save the profits which private companies would make from the sale of power, both for public utilities and private consumption. An opinion which seems to be held pretty widely in Ontario is that the supplying of power is a municipal duty and that the towns owe it to their citizens to secure them this service at the lowest possible rates. When the report was made it was received with general satisfaction, if we may judge from the Ontario papers, but, on second thought, the great expense involved, which will be from $9,000,000 to $12,000,000, seems to have caused some apprehension; and there is now a desire to have the government undertake the work and lay out the money and look to the towns for gradual reimbursement.

The construction of another power plant at Niagara falls would be unfortunate at this time, particularly so as those already in course of erection will have a total output considerably greater than there is now any demand for.

SOURCES OF POWER.

One occasionally hears the expression, "new sources of power," used in an entirely incorrect manner. In fact, a good many people do not seem to differentiate between a source of power and a means of utilization. Not infrequently it is said that we need not worry at the present time about our inroads upon our fuel resources, because long before they are used up we will have discovered some new source of power; that we somehow or other always meet these emergencies as they arise; for example, when horse-car traction became inadequate, electric power was ready to take its place; that the old source of power—the horse—was displaced by the new source of power—electricity. This is, of course, a mistake, for we have yet to discover an electrical method which will make available a new source of power. In fact, there has been no new source of power discovered since the finding of coal, if we except, of course, the new discovery of radioactivity. Our engineering methods are not opening new sources of power; they are merely helping us to utilize those which we already have at hand. In fact, every improvement which we make puts a greater drain on our resources, for everything that tends to cheapen power tends to make it more widely used. We are to-day accomplishing results through the burning of coal where formerly we relied upon animal power or the crank turned by hand; and we are burning vastly more fuel for such purposes than ever before.

We have therefore no good reason on which to base a prediction that before our fuel resources are exhausted a new source of power will be available. There is the suggestion, of course, that such an outcome may result from further study of radioactive materials, but we know too little about this subject at the present time to make any predictions. For these reasons every effort to economize our fuel supplies is commendable, and it is perhaps just as well to realize that the greatest waste of fuel is not due to our power stations, but due to our methods of employing coal for heating purposes; and it would seem that the problem should be attacked at this point if any appreciable saving is to be effected.

THE NEW YORK-NEW HAVEN CONDUIT SYSTEM OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

On other pages of this issue will be found a description of the conduit system extending from New York city to New Haven, Ct., recently completed by the American Telephone and Telegraph Company. So great has been the growth of telephone service that the overhead network has, in many localities, become so extensive that compacting into cable form has been necessary. Then, again, the immunity from interruption by reason of storm or other atmospheric casualty is an important factor in determining the very great investment which is involved in a permanent conduit system such as is here described. While the distance between New York city and New Haven is some seventy-odd miles, the cable system which will be installed in these subways is essentially a short-haul system. Use will be made of the Pupin loading coil for the long-distance line, but it must be remembered that this conduit system has been built with reference to the local exchanges in the towns through which it passes. The American Telephone and Telegraph Company is expending large sums of money upon its underground construction. As was pointed out in the recent annual report, at the end of 1905 there were 95,000,000 duct feet of underground conduit installed. The New York-New Haven system is the longest continuous conduit system yet completed. Rights of way, however, have been secured clear through to Philadelphia, Pa., and in other parts of the country extensive work of this nature is going on or is about to be undertaken.

The Long-Distance Underground Conduit System of the American Telephone and Telegraph Company between New York, N. Y., and New Haven, Ct.

THE very rapid growth of telephone facilities, with the consequent demand for certainty of service, has brought about a condition in many localities rendering it physically impossible to maintain a sufficiently extensive network of overhead wires to complete the subscribers' circuits. The opportunity for

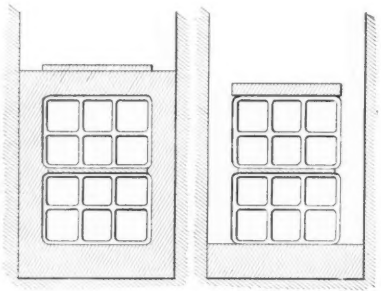


FIG. 1.—METHOD OF LAYING TWELVE-HOLE MULTIPLE DUCT.

compacting the service into cables carrying many pairs of wires and placing these cables underground in conduits where they will be free from everything but extraordinary disturbances has led to the very rapid growth of telephone subway construction. One of the most interesting installations for the reception of under-

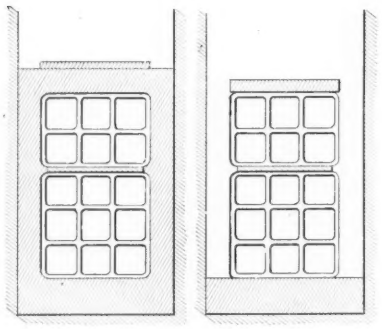


FIG. 2.—METHOD OF LAYING FIFTEEN-HOLE MULTIPLE DUCT.

ground cables has recently been completed between Greenwich lane in Stamford, Ct., and the central office at New Haven, Ct. The underground conduits of the New York Telephone Company, extending from its large exchanges in the heart of the business district of New York, run through the island of Manhattan, through the borough of the Bronx and Westchester county to the state line in the old village of Greenwich, a distance of about twenty-five miles. From this point the conduit system of the American Telephone and Telegraph Company is laid through the towns of Stamford, Darien, Norwalk, Westport, Fairfield, Bridgeport, Stratford, Milford, Orange and New Haven, a distance of forty-two and one-half miles.

The work on the Stamford-New Haven conduit system was divided into three main sections. The section from Stamford to Fairfield (110,000 trench feet) was handled by G. M. Gest, the well-known subway contractor of Cincinnati and New York. The Bridgeport section (30,000 trench feet) was built by the Southern New England Telephone Company, and the Stratford-New Haven section (85,000 trench feet) was built by the Bunting Construction Company. The whole conduit system has been built with reference to the needs of the companies supplying the local service of the towns along the route. While in many sections entirely new construction was undertaken, in the towns

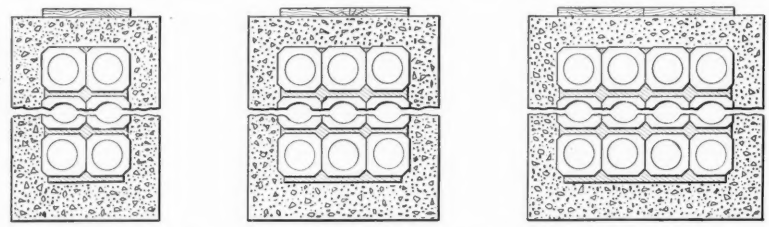


FIG. 4.—METHOD OF LAYING SINGLE TILE DUCT.

the work was sometimes one of enlargement and rebuilding of present systems, additional ducts being placed wherever the local conditions demanded. In this way

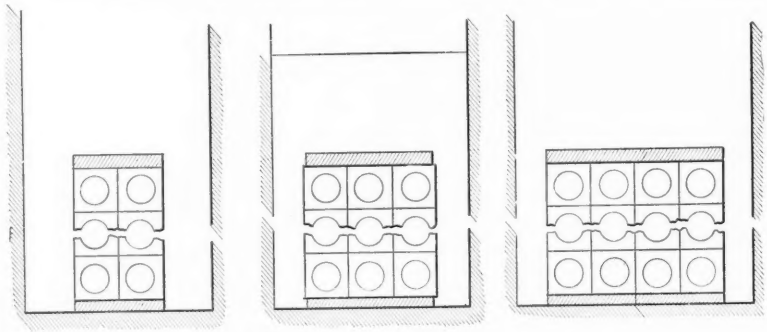


FIG. 5.—METHOD OF LAYING CREOSOTED WOOD DUCT.

the runs of the conduit system vary from six to thirty ducts. Several kinds of duct were used, preference being given to one or the other according to the physical conditions of the country, the obstacles met with and the probability of future excavation or blasting in the locality.

Salt-glazed vitrified tile conduit was

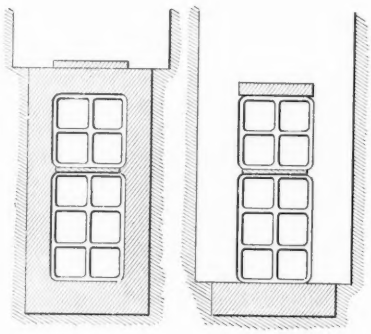


FIG. 3.—METHOD OF LAYING TEN-HOLE MULTIPLE DUCT.

used in the greatest proportion, the well-known Camp single and multiple duct being used for this class of work. Wherever the number of ducts permitted, and for all ordinary work, multiple duct was used, single duct being used where greater flexibility in passing obstructions was needed and where enlargements of existing systems were made.

Where heavy rock cuts were encountered creosoted wood duct was used, as this offers less possibility of shattering where

future blasting might cause trouble with a tile duct. Where it was necessary to cross bridges, the custom was to use wrought-iron pipes encased in concrete,

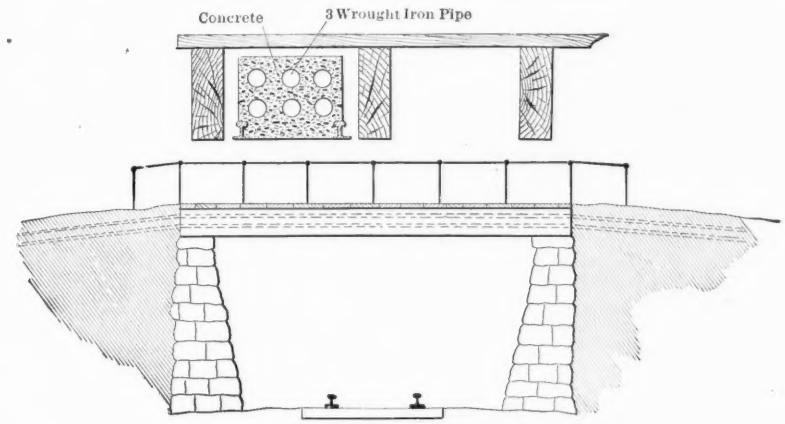


FIG. 6.—STANDARD METHOD OF CROSSING SHORT BRIDGES.

where possible. Where water was encountered, tile duct entirely encased in concrete was used. At two points, crossing the Saugatuck and the Housatonic rivers, submarine cables were made use of, and in crossing other streams tile duct entirely encased in concrete was laid under the bed of the river.

In digging the trench for the conduit system the width and depth of the cut varied somewhat with reference to the local conditions. Unless the character of the locality was known, either through previous work or from data available through county records, test pits were excavated to determine the character and extent of obstructions. As nearly as possible absolute grade lines were obtained, and the laying of the duct was in conformity with the true grade of the road. The ducts are laid so as to drain into either or both manholes with a fall of five inches in 100 feet.

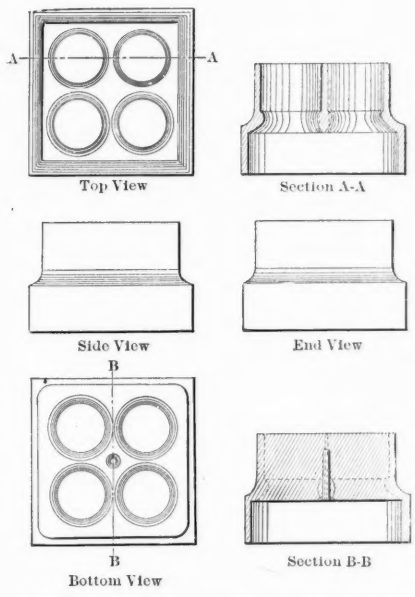


FIG. 7.—SPECIAL CASTINGS USED FOR CONNECTING FOUR-HOLE TERRA-COTTA DUCT TO THREE-INCH IRON PIPE.

Fig. 1 and Fig. 2 show the method of laying twelve and fifteen-hole multiple ducts. Fig. 3 shows the method of laying ten-hole multiple ducts.

The width of the trench excavation was made ample to permit convenient laying of the ducts, and in no case was less than three inches of clear space provided on each side of the ducts as laid, not counting any side reenforcement subsequently placed. The depths of the trench were such that the distances from the correct grade of the street to the top of the top tier of ducts were not less than two feet six inches for multiple and single tile duct, allowance being made for future possible changes in the street grade. Where gas service pipes were encountered the conduits, wherever possible, were placed below these. The bottom of the trench was carefully smoothed and trued to grade, and where refilling was necessary the best of the excavated material was used, solidly tamped in place. Where necessary, the sides of the excavation were shored up by suitable planks, and in some cases the shoring or braces used in the excavation formed a part of the permanent construction. The excavations were kept free from water by pumping and bailing and by permanent draining. Soft places were filled in with concrete and planking.

The foundation for the multiple tile conduit consisted of a bed of concrete at least four inches thick and of a sufficient width to extend not less than three inches on each side of the assembled conduit. Before laying the ducts the concrete foundation was permitted to set for a sufficient time to ensure its freedom from injury during the work.

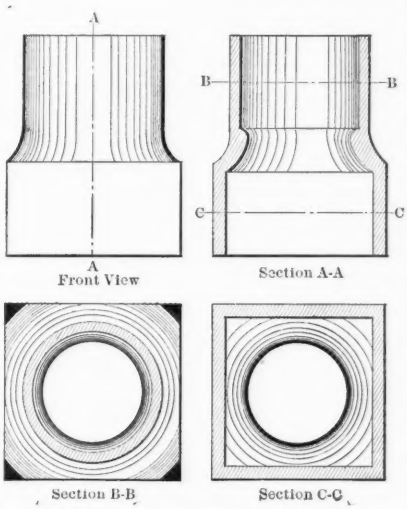


FIG. 8.—SPECIAL CASTINGS USED TO CONNECT SINGLE CREOSOTED WOOD DUCT TO THREE-INCH IRON PIPE.

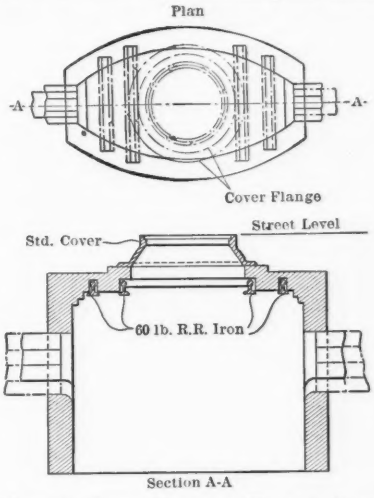


FIG. 10.—BRICK MANHOLE, TYPE A, TWO-WAY, SIX TO NINE DUCT.

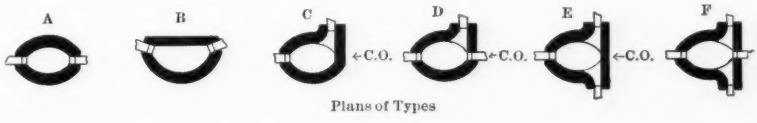


FIG. 9.—PLANS OF DIFFERENT TYPES OF BRICK MANHOLES.

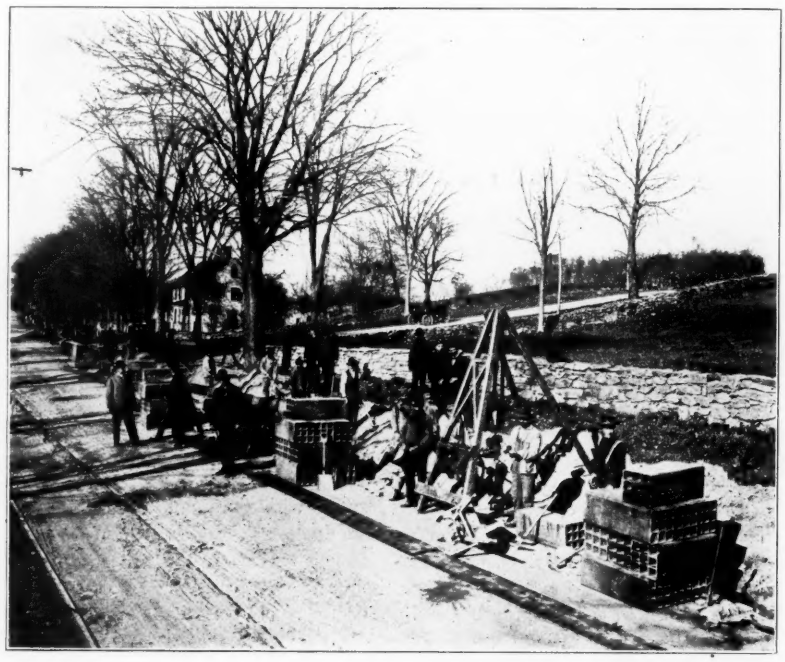
In placing the duct upon the concrete foundation, sufficient mortar was used as a bed to ensure an even bearing for the duct at all points. The proper registering of the adjacent duct sections was secured through the use of iron dowel pins, and the duct was set with mandrils, pulled through as the work progressed.

The joints between the duct sections were protected by a collar of cement strengthened by cheese-cloth. A piece of cheese-cloth eight inches wide and of sufficient length to wrap one and one-half times around the joint was saturated with thin pure cement grouting. The cloth was wrapped around the joint so that the ends of the strip hung down on each side of the duct section. A collar of cement mortar was then formed over the cloth

A Run of Multiple Duct, New York-New Haven Conduit System, American Telephone and Telegraph Company.

wrapping on the sides and top of the duct section. This cement mortar collar was about three-eighths of an inch thick and of sufficient length to cover the cloth wrapping. Wherever two or more multiple sections were required to make up the requisite number of ducts a layer of cement mortar not less than three-eighths of an inch thick was placed between the sections, and all the joints were staggered. The joints were staggered by using short duct sections. After completing the joint sufficient time was allowed for the cement collar to harden properly before any further work of protecting the ducts was begun. Wherever concrete was required on the sides or top of the ducts this was filled in at least three inches thick and solidly tamped in place. After the ducts were laid, properly jointed and the concrete protection had been completed, a creosoted plank was placed on top of the conduit in a central position. This plank was of the width of the tile duct and one and one-half inches thick. In locations not exposed to danger of settlement of the ground or possible excavating, the side and top protection by concrete would be omitted, but the one and one-half-inch creosoted plank would still be retained in position. After the creosoted plank was in place the back filling of the trench was completed.

Where the conditions of the ground demanded the construction would be flattened out. The construction shown in Fig. 3 would be laid upon its side, making the creosoted plank the width of five ducts. This was in order to give the ducts as broad and solid a bearing surface as possi-



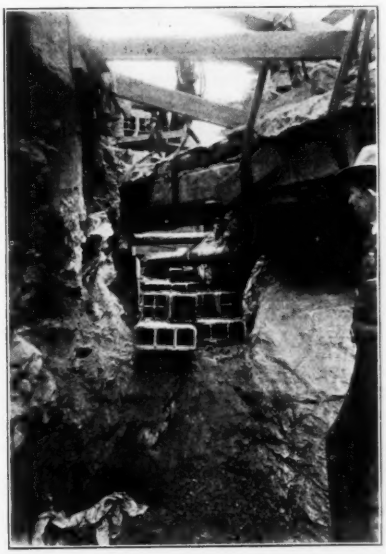
New York-New Haven Conduit System, American Telephone and Telegraph Company.

One of the Manholes, New York-New Haven Conduit System.

ble. As stated before, wherever enlargement work was undertaken, or where greater flexibility was required in passing obstructions, single tile duct was used. Fig. 4 shows the method of laying single tile duct. The foundation for the single tile duct consisted of at least four inches of concrete of a sufficient width to extend not less than three inches on each side of the assembled conduit. The duct was embedded upon sufficient cement mortar to secure an even bearing at all points. Mandrils similar to those used for multiple duct were drawn through, and the ducts so laid that the joints were broken both vertically and horizontally true to line and arranged so that no offsets or shoulders should form in the bores. The duct sections in each tier were laid close together without any intervening layer of mortar, but each tier was bedded upon sufficient mortar to secure an even bearing. The joints in the top of the tier were protected by a layer of cement mortar, and the exposed joints in the sides were similarly protected. After the mortar was sufficiently hardened, the sides and the top of the conduit were protected by at least three inches of concrete solidly rammed into place. After the duct had been laid and the concrete properly set, a one and one-half-inch creosoted plank was placed over the duct, this plank having a total width equal to the tile portion of the conduit. After the creosoted plank was placed, the back filling of the trench was completed.

One of the Manholes, New York-New Haven Conduit System.

A Manhole on the New York-New Haven Conduit System, American Telephone and Telegraph Company.



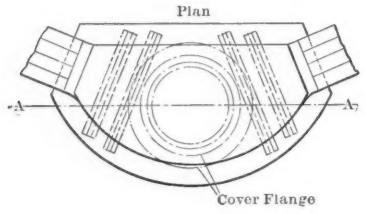
Passing under and through Obstructions.

Where the character of the ground was such that blasting was necessary and there was a possibility of future blasting, also for swampy sections, creosoted wood ducts were used. Fig. 5 shows the method of laying creosoted wood duct. No foundation other than that of the bottom of

One of the Obstructions Met with in Conduit Work.

the trench, properly graded and smoothed, was used for the creosoted duct, except where there was danger of settlement or washing away. In this case a creosoted plank foundation was used. The creosoted duct was laid so as to break the joints both vertically and horizontally, and in joining the ducts the tenons were driven completely home into the mortise. Over the top of the creosoted wood a one and one-half-inch creosoted plank of the same width as the assembled conduit was laid, the back filling of the trench completing this section of the work.

Wrought-iron pipe was generally used to pass obstacles, its arrangement depending almost entirely on the local conditions. Wherever possible the wrought-iron conduit was protected by a complete encasement in concrete, so as to have at least two inches of concrete around the assembled pipes. The pipes were



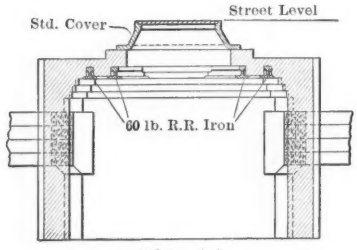


FIG. 11.—BRICK MANHOLE, TYPE B, TWO-WAY.

separated by at least two inches of concrete.

The standard method of crossing short bridges is shown in Fig. 6. This construction makes use of standard T rails filled in with concrete.

Wherever changes were made from single or multiple tile to creosoted wood duct, or vice versa, special castings were used. These are shown in Fig. 7 and Fig. 8, which show, respectively, the method of connecting four-hole terra-cotta and single creosoted wood ducts to three-inch iron pipe.

Where poor foundation was discovered and where there was danger of under-excavation or washouts from overflow of streams or freshets, the concrete bed and the sides of the conduit protection were reenforced with twisted steel wire, each double strand having a breaking strain of 8,000 pounds.

The system contains nearly 500 manholes, the distance between manholes averaging a little over 400 feet, while the maximum distance is 614 feet. The manholes are constructed of brick, the form of manhole being determined by the local conditions. Fig. 9 shows plan views of the various types of manholes, Figs. 10, 11 and 12 showing plans and elevations in detail. In many cases the building of the manholes involved the dismantling of existing structures, the accommodating of existing cable systems and in some cases the enlargement of existing manholes. Of the number of manholes, 437 were of type A, six of type B, nineteen of type D, six of type E, eight of type F, fifteen square manholes and several of special construc-

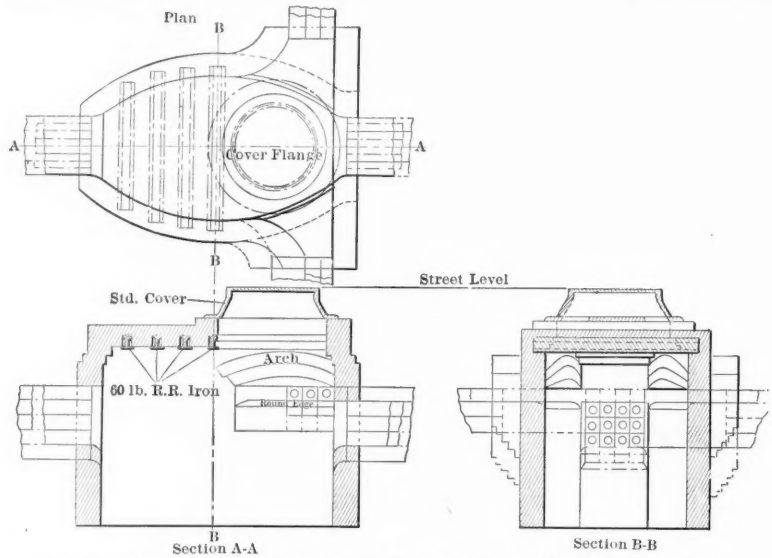


FIG. 12.—BRICK MANHOLE, TYPE C, D, E, AND F, TWO, THREE OR FOUR-WAY, NINE TO TWENTY DUCT.

tion. In most cases the natural earth forms the floor of the manholes, which permits the gradual seepage away of any surface water which might collect. If, however, the manholes were located in wet ground, a special flooring of concrete was used, and, where possible, drains were installed.

For the accommodation of the cables bolts were let into the mortar filling and creosoted planks arranged about the sides. The manholes are fitted with standard castings and covers, a detail of which is shown in Fig. 13.

The accompanying half-tone illustrations are reproductions of typical views along the route. These illustrations show some of the obstructions met with and demonstrate the need for engineering ability of a high order. The views are presented through the courtesy of G. M. Gest, who has taken a very prominent part, both here and abroad, in solving problems of underground conduit laying.

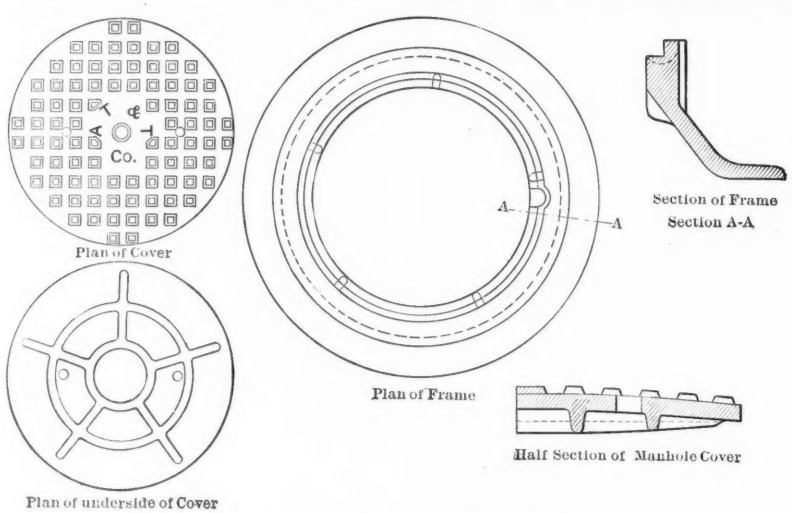


FIG. 13.—DETAILS OF MANHOLE COVER CASTINGS.

Electrical Notes from Europe.

(By Our Special Correspondent.)

NEWS has appeared from time to time about the project for building an electric railway to the summit of Mont Blanc. We are now able to give some more definite information about the line which is to be built, seeing that one of the projects has been officially accepted. The summit of Mont Blanc lies at an altitude of 14,830 feet. This great height has a considerable influence upon the conditions of construction of the electric line, especially as regards the barometric pressure and the temperature. It is found that the speed must be limited, so that the change is not too abrupt, as this would be disagreeable for the passengers. There is a fall of twenty-five degrees centigrade in the temperature from Fayet, the starting point of the line, to the summit of the mountain. The proper rate is about eight degrees per hour for the passengers, so that the speed has to be limited to 4,000 feet per hour for the climb. It will thus take about four hours to reach the top of the mountain. That the Mont Blanc electric line is shortly to enter upon the phase of construction is evident from the fact that the government has recently adopted the project of M. Duportal, general inspector of roads and bridges, and has awarded the contract for building to Couvreux & Deraud.

According to the Duportal project, the line is to start from the station of Fayet, on the Paris, Lyons & Mediterranean Railroad, and will ascend the southern slope of the mountain, as here there is an easy grade. The line reaches St. Gervais and the Bellevue Chalet at an altitude of 5,890 feet, then Mt. Lachat (7,000 feet), the Tete Rousse (10,550 feet) and the Aiguille du Gouter (12,800 feet). At the latter point the first section of the line stops, and the remaining part will be built later on, seeing that the second part calls for a series of plans and projects which have not as yet been drawn up, and this will only be done after the first section is in operation. The first part of the line has a total length of eleven miles and the end lies about 2,030 feet from the summit of the mountain.

The highest vertical speed of the climb will be 4,000 feet per hour and the grades of the road are not to exceed twenty-five per cent. As to the curves the least radius is 160 feet. The usual narrow gauge of one metre (39.37 inches) has been chosen in this case. A narrow gauge can not be used, seeing that the top of the cars is to lie nine feet above the rails and the cars have to be very steady, seeing that the wind on the mountain gives as high a pressure as 200 pounds per square yard. The rails are to be thirty-five feet long and will weight forty-five pounds per yard. Each rail will be laid upon twelve metallic ties and the rack for the system will be laid in the middle between the rails. The rack-and-pinion system will be needed in this case, as on most of the Swiss mountain roads. The length of the rack sections is 11.7 feet and the rack rail weighs eighty-six pounds per yard.

As to the road construction it is found that this will be comparatively easy to carry out, as the track can be laid up the side of the mountain for the most part, and only a few cuts or fills will be needed. The road winds up the sinuosities of the mountain on an easy grade. From Fayet it rises to the Col de Voga, from whence a fine view is to be had of the valleys of Bionasset and the Arve. The line turns around the Pic des Rognes and rises to a point above the Tete Rousse, reaching the glacier region at an altitude of 11,500 feet.

According to the project the trains will be made up of an electric locomotive weighing fifteen tons, which will draw two passenger cars of four tons each. These cars are to hold eighty passengers in all and the whole train, when fully loaded, is to weigh thirty-five tons. The capacity of the locomotives is to be 150 horse-power. As it is proposed to have eight trains running on the line at once, some 1,200 horse-power will be needed for the motors, or, allowing for the electric heating, about 1,400 horse-power must be furnished by the electric plant. The latter will be laid out for an ultimate capacity of 3,000 horse-power to provide for the second section of the road running to the summit. The estimated cost of the system is $2,000,000, or about $200,000 per mile, including the generating station and the electric outfit, which are estimated at $300,000. Once the road is in operation there will no doubt be a number of large hotels erected at different heights on the mountain, such as are found upon many of the high points in Switzerland.

Marseilles is one of the best equipped cities of Europe as regards electric tramways. According to a recent report the total length of all the tramway lines in the city, including double-track parts and side tracks, is over 120 miles. This extensive system was finished and put in operation in 1904, but there were still some quarters of the city which were not well provided with lines, so that in 1905 it was decided to put in city and suburban lines to the extent of thirty miles. Different construction is used in the various sections as regards the track. For instance, on the Humbert section there is a sixty-pound rail laid upon metallic ties by means of cast-iron cushions. This track was already in place for the animal traction and the rails were then given Falk joints, with a greater number of ties added. A second section has a heavier rail of 112 pounds. The rails are braced across and the whole is laid on a sand and gravel foundation. One of the suburban lines has the same construction, but uses a ninety-two-pound rail. A few of the lines use a light fifty-five-pound Vignole rail laid upon oak ties.

As regards the central station which has been built within the last few years for operating the Marseilles system, it is a large one and contains the most modern apparatus. In the boiler room there are four batteries of five boilers each, having 220 square yards heating surface. The boilers are of the semi-tubular type. In addition to these there is a battery of four boilers of 260 square yards surface, provided with Green economizers. Later on a new battery was added, consisting of four Babcock & Wilcox boilers having a heating surface of 400 square yards each. These are provided with mechanical stokers and coal conveyors, which are operated by electric motors. All the semi-tubular boilers are equipped with smoke consumers of the Marronier pattern. To secure a constant firing of the boilers an ingenious system has been employed in the station. The main pressure gauge is made to control the action of a signal system consisting of a motor-driven commutator drum by which a series of signals is sent to the firemen at points opposite each furnace. Bells and lamps are used for the signals.

Marseilles has now about the longest traction system which is to be found in any of the large cities on the Continent. Owing to the free use of the trolley it has the advantage over many other cities. The total length of 120 miles of track corresponds to 14.5 miles per 10,000 inhabitants. In Germany, where the cities are the best provided on the Continent, there are only 9.1 miles for Düsseldorf and 9 miles for Cologne, which are at the head of the list. As many as seventy million passengers were carried on the lines in 1904, making 104 trips per person.

C. L. DURAND.

Paris, April 2.

BOOK REVIEWS.

"Les Procédes de Commande à Distance au Moyen de L'Electricité." Régis Frilley. Paris. Gauthier-Villars, Imprimeur-Libraire. Paper. 190 pages. 4¾ by 7½ inches. 94 figures. Price, 3 francs 50 centimes.

This book discusses the various methods which have been employed for controlling or regulating apparatus from a distance. The author does not go into details of the different systems, though he explains clearly the principles of each, using diagrams to illustrate their operation. He divides the discussion into sections, dealing first with apparatus controlled directly, such as controlling the speed of motors, then the use of relays for various purposes. A great many applications have been made of this method. The use of revolving fields is more limited, but also important. Applications of the Wheatstone bridge principle are explained, as well as the use of induction coils, sparks, ratchet appliances and other devices. A short chapter is devoted to the discussion of distance control by means of Hertzian waves.

"Care and Management of Electric Power Plants." Revised edition. Norman H. Schneider. New York. Spon & Chamberlain. Cloth or leather. 290 pages. 5 by 7½ inches. 205 illustrations. Supplied by the ELECTRICAL REVIEW: cloth, $1.50; flexible leather, $2.50.

This work is intended as a handbook of practical information for the operators of electric power plants. It is primarily prepared for persons who have had little or no experience in such work, but it contains a large amount of information valuable to the more experienced engineer. Chapter i discusses electrical conductors. Chapter ii takes up the problem of the distribution of wiring. Chapter iii deals with the generation of electric currents, both direct and alternating, and chapter iv with their utilization in motors. Chapter v deals with the methods of testing various parts of the system. Chapter vi discusses the problem of the storage battery and chapter vii the incandescent lamp, its use and methods of testing. The final chapter gives some valuable notes on general engineering.

"Experimental Electrochemistry." N. Monroe Hopkins. New York. D. Van Nostrand Company. Cloth. 284 pages. 6¼ by 9 inches. Diagrams. Supplied by the ELECTRICAL REVIEW at $3.

It is the aim of the author of this book to produce a useful laboratory and lecture room manual to supply, as far as possible, the great lack of definite information concerning the manipulation during electrochemical experiments. The subject is treated historically, frequent reference to great names aiding materially in holding the student's interest. After recounting briefly the earliest work in this branch of chemistry, the modern theory of dissociation is discussed and the analogy pointed out between the behavior of solutions and gases. Instructions are given for the carrying out of experiments in the laboratory, and the descriptions of commercial types of apparatus which are added keep the student aware of the fact that he is studying a subject which has great commercial importance as well as scientific interest. A valuable bibliography, chronologically arranged, is appended to the book.

"Electric Power Transmission." Fourth edition enlarged. Louis Bell. New York. McGraw Publishing Company. Cloth. 722 pages. 6½ by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $4.

This edition of Dr. Bell's well-known work has been necessary in order to bring the volume up to date. So much has been done and so rapid has been the development in electrical transmission that it is almost impossible to keep the literature in step with the engineering. In the revision it has been necessary to eliminate a good deal of descriptive matter contained in the early editions in order to make room for new material. This is particularly true with regard to the methods and apparatus for transmitting and distributing electrical energy. A good deal of attention has also been devoted to the accessory apparatus becoming so important in modern stations. It is a noteworthy fact that while the earlier volumes contained lists of plants in which a pressure of 10,000 volts was used for transmission purposes, in the present edition nothing under 20,000 volts is included in the list. In fact, 10,000-volt plants have become very commonplace.

"Physical Chemistry for Electrical Engineers." J. Livingston R. Morgan. New York. John Wiley & Sons. Cloth. 230 pages. 5 by 7½ inches. Diagrams. Supplied by the ELECTRICAL REVIEW at $1.50.

This book is intended for the student of physical chemistry as well as for the professional electrical engineer. In it the author discusses clearly, but in an unbiased manner, those phenomena lying in the borderland between chemistry and electricity. This is a field which has been sadly neglected until within the last few years, although there have been a number of persistent, conscientious workers who have brought to light many highly important facts. These facts are presented in as popular a manner as is consistent with quantitative results. The author endeavors to avoid theorizing, preferring rather to state the facts as they are, leaving the student to draw his own conclusions. The work explains briefly the fundamental principles of physics and the properties of gases. It then takes up heat and its transformation into other forms of energy, passing thence to a study of solutions as developed by the German workers. The important subjects of mass action and equilibrium in electrolytes are fully considered. A number of instructive problems appended add to the usefulness of the book.

"Engineering Mathematics Simply Explained." H. H. Harrison. New York. Spon & Chamberlain. Cloth. 166 pages. 5¼ by 8 inches. Diagrams. Supplied by the ELECTRICAL REVIEW at 75 cents.

This is an unusually valuable little book for the student or the engineer who has, unfortunately, not been able to study the higher branches of mathematics, or who is a little rusty in his use of them. The book, however, does not assume much previous training in mathematics, but begins with simple arithmetic, explains the underlying principles and shows how shorter methods may be used. After carrying the student through the various divisions of this part of the subject, each step being made carefully and the reasons for it clearly stated, algebra is taken up, which is treated in much the same way. Here not only are the general laws given, but the method of determinants is explained briefly and in an unusually clear manner. In two or three pages the student gets enough information about this labor-saving method to be able to apply it himself. Trigonometry is taken up in the same satisfactory way. Then follows mensuration, which, in turn, is followed by logarithms. Here again the author is happy in his method, for he first shows the student the advantages of the logarithmic method of computation and then introduces him to the tables. A useful chapter for engineers is that devoted to discussing the utility of squared paper. Unfortunately, mathematical instructors are apt to neglect this subject. The last chapter of the book deals with the differential and integral calculus. In such a short work the student can not be carried very far, but he is taught enough of the subject to understand its principles and to see how exceedingly valuable it is to the engineer. The typographical work of the book is, on the whole, excellent, although there are one or two unfortunate errors which will not be apparent to the student on first reading and which may give him trouble.

American Machinery in Foreign Countries.

It is interesting to note that industrial development now taking place in countries whose civilization began centuries before our own. The rapid assimilation of electrical machinery in those countries is particularly remarkable and a glance at the orders received for such apparatus not only brings out this point, but also indicates the diversity of these enterprises.

Japan is representative in this regard. Within a comparatively few years this empire has advanced rapidly in many phases of modern engineering. In the field of electric lighting Japan is well advanced, particularly in the matter of equipment. The Nagoya Electric Lighting Company is about to install its second 500-kilowatt Curtis steam turbine for this purpose. The additional equipment includes also a nine-panel switchboard and a small twenty-five-kilowatt horizontal Curtis turbo-exciter set made by the General Electric Company. The last-mentioned machine indicates how closely the Japanese engineers follow American practice, even in details.

Another country, old in civilization, is adopting American electrical apparatus for power, lighting and railway work. Note has already been made in these columns of the electrical transmission plans for the Kashmir valley and another order from India illustrates a different line of work. The Rangoon Trams, of Rangoon, Burmah, have purchased twenty-five G. E. 80 railway (forty horse-power) two-motor equipments for service on their systems.

In the western hemisphere Mexico represents a civilization perhaps as old as that of the Japanese, and here again is found the same awakening in industrial enterprise. Mexico is rapidly coming to the front ranks of the commercial army, both in agricultural and mineral development. Many mining properties are being extended and electricity is one of the chief factors. In this connection the American Smelting and Securities Company has ordered power-house equipment for its Velardena mines. This apparatus includes two General Electric 450-kilowatt, three-phase revolving field generators complete with switchboards and exciters. Electricity from the famous Necaxa falls power development will be used in Mexico City for lighting, power and railway purposes. The railway lines are operated by the Mexico Electric Tramways, Ltd., and this company will also use machinery and railway apparatus built in the United States. The entire equipment for the railway will be furnished by the General Electric Company, of New York, and will consist of four complete substation equipment generator sets, exciter sets and complete switchboards for each substation. The cars will be operated by General Electric two-motor and four-motor equipments in addition to many which are already in service.

American Society of Mechanical Engineers.

The fifty-third meeting of the American Society of Mechanical Engineers will be held at Chattanooga, Tenn., May 1 to 4. Certificate rates of a fare and a third for the round trip have been secured. This concession of one-third fare for the return trip is subject to the condition that at least 100 persons holding certificates shall present them to Francis W. Hoadley, assistant to the secretary, with twenty-five cents for the fee to the railroad association, not later than May 4, for his endorsement and the subsequent endorsement of the agent of the railway associations at Chattanooga.

Sessions will be held throughout the entire meeting at the Read House. The address of welcome will be delivered by Mayor W. L. Frierson, and the response will be made by Fred W. Taylor, president of the society.

On Wednesday afternoon, May 2, there will be a trolley ride for the ladies and members to the Chickamauga-Chattanooga National Military Park, Chickamauga battle-field and the United States Army Post. Carriage drives will be made through the battle-field and park, where the monuments and historic tablets will be reviewed. The Twelfth United States Cavalry will give a regimental drill in honor of the visitors.

On Thursday morning the subject of water-wheel governing will be taken up for discussion. On Thursday afternoon, May 3, there will be an excursion to Lookout mountain, and on Thursday evening at 8 o'clock the local members of the society with other citizens of Chattanooga will tender a reception to the members and ladies at the Read House.

On Friday morning, May 4, there will be an excursion for members and ladies to Missionary Ridge and other points of interest about the city, and on Friday afternoon there will be an excursion on the steamboat Chattanooga along the Tennessee river through the mountain section below Chattanooga to Hale's Bar.

Trackless Trolley Systems.

Consul-General Thackara, of Berlin, Germany, in response to a recent request for information regarding trackless trolley systems in Germany, states that at Eberswalde, in 1901, there was an experimental trackless trolley system installed by a Berlin engineer, Joh. Brandt, for the "Compagnie de Traction par Trolley Automoteur," but after having been in operation a little over five months it was withdrawn. This French company, with a capital of $386,000, was formed for the purpose of exploiting the patents of the Lombard-Guerin system. Having sold its patents it is now in course of liquidation. The length of the line was 3,280 feet, running from Eberswalde railroad station to the centre of the town. The roadbed was fairly good. Current was transmitted at 550 volts on a line of parallel copper conductors 0.315 inch in diameter, 11.8 inches apart. Current was transmitted by a flexible cable from an overhead trolley, which was so adjusted that it always ran a short distance ahead of the car. The flexible cable contained six insulated wires, three for a three-phase motor, which operated the traveling trolley, two for the motors on the car and one for operating an electromagnetic brake to check the trolley in case the car stopped on a grade. The average consumption of current at the central station was 660 watt-hours for 3,280 feet per omnibus. The weight of the omnibus was 7,496 pounds. The maximum speed was 8.7 miles per hour. An eight-horse-power motor was attached to each of the rear wheels. These two motors, however, were capable of producing twenty-five horse-power for a short time. This was all the power necessary to start the omnibus. Power transmission was by means of chains and cogs. The omnibus was constructed to carry eighteen passengers seated.

The American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association will be held at Columbus, Ohio, the week of October 15-20, 1906. Affiliated with this association the members of the American Street and Interurban Railway Accountants' Association, Engineering Association, Claim Agents' Association and Manufacturers' Association will hold their conventions. The days upon which the different associations will hold meetings will be given attention at an early date.

The American Street and Interurban Railway Manufacturers' Association will hold the customary manufacturers' exhibit, the exhibit halls being located on the state fair grounds, which are within fifteen minutes' ride of the principal hotels. There are six adjoining brick exhibit halls, and in addition there are three covered sheds with brick pavements. The Manufacturers' Association will have a larger and more comprehensive exhibit than at any time in the past. The Big Four Railroad tracks will run directly to the buildings.

Westinghouse Electric and Manufacturing Company Election.

At a meeting of the board of directors of the Westinghouse Electric and Manufacturing Company, held Tuesday, April, 10, L. A. Osborne, formerly third vice-president of the company, was elected second vice-president, to succeed Frank H. Taylor, resigned. Mr. Taylor, who is also a director of the company, will retain his seat on the board.

Mr. Osborne's duties as third vice-president comprised the direction of the engineering and manufacturing activities of the company. As second vice-president he will assume the direction of the commercial activities of the company, while retaining those of the engineering department.

The new second vice-president is a graduate of Cornell University and entered the employ of the Westinghouse Electric and Manufacturing Company in 1891. He has successively held the positions of assistant superintendent, assistant to the vice-president, manager of works, fourth vice-president and third vice-president.

The National Electric Light Association.

The twenty-ninth convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 5, 6, 7 and 8, bids fair to surpass any previous session. Not only is an interesting and valuable program of papers being prepared, but the entertainment features will be complete, and early reservations of exhibit space are progressing satisfactorily.

The arrangement for reduced fare from almost every point in the United States to Atlantic City has been completed, and it is expected that special trains will run from Chicago, New York, Boston, Buffalo and Philadelphia. George F. Porter, 120 Liberty street, is master of transportation.

Lead Production of Canada.

The lead production in British Columbia, during the last year, and the bounty paid by the Dominion government are just available. The returns of shipments to the Canadian reduction works at Trail from July 1, 1904, to June 30, 1905, show that the St. Eugene mine produced 6,247,508 pounds of lead and the North Star 2,082,903 pounds. The total shipment of the Province was 29,874,756 pounds. The total lead produced and treated amounts to 33,730,546 pounds and the bounty to $240,288. The amount exported was 2,197,298 pounds, on which the bounty paid was $96,579.

A NEW METHOD OF TURBINE CONTROL.[1]

BY LAMAR LYNDON.

One of the difficulties encountered in controlling hydraulic turbines is due to the inertia of the moving column of water. This can not be changed instantly by a sudden change in the gate opening, consequently if the gate be opened rapidly there will be a drop in the pressure in the pipe, and, conversely, if it be closed, a shock will take place which may be dangerous.

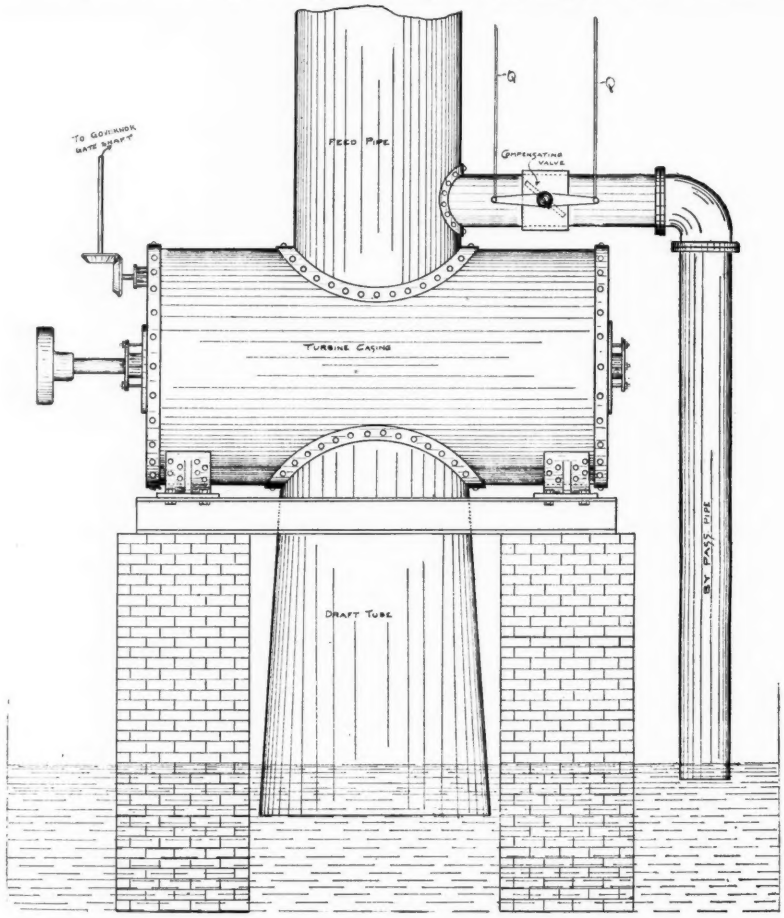


FIG. 1.—METHOD OF GOVERNING HYDRAULIC TURBINES, SHOWING BY-PASS PIPE AND COMPENSATING VALVE.

To provide against the latter it is customary to place relief valves on the penstocks where the head of water is high, so as to allow a slight discharge to take place, and in this way absorb the blow, or to take up the shock in some other way. Obviously, such conditions must interfere considerably with the sensitiveness of the controlling apparatus. It is to overcome these difficulties and also to prevent what is known as overrunning or underrunning that the following system has been devised. By overrunning is meant the oscillatory movement of the gate which takes place if the governor be not returned to its normal position before the gate opening has been properly adjusted. By underrunning is meant the step-by-step movement which will result if the governor be returned too quickly to its normal position.

Fig. 1 illustrates the feature of the governor which is employed to prevent a shock due to a sudden change in the gate opening. A by-pass pipe is led from the feed pipe around the turbine, and in this is placed a compensating valve of the butterfly type. This valve may be used in two ways: one where the flow of water is more than that required by the turbine. In this case the valve is set partially open, so that there is always a flow of water through it. It is so connected to the governing device that when the turbine gate is closed the compensating valve is opened a corresponding amount, so that there is no sudden change in the flow of water in the feed pipe. On the other hand, opening of the turbine gate is accompanied by a clos-

[1] Abstract of a paper read before the Philadelphia section of the American Institute of Electrical Engineers, April 9.

ing of the compensating valve, so that the additional water called for by the turbine is supplied by the water which was previously passing through the by-pass pipe. In this way all shocks are taken off the turbine gate and a constant pressure is maintained.

Where it is not advisable to allow water to pass through the by-pass valve continuously this valve is normally kept closed, so that it acts only to prevent shocks, opening when the turbine gates are closed.

In order that the compensating valve may be always in a position to act, it should stand normally half open and should be returned to this position slowly so as not to cause a shock after the turbine gate has been adjusted for the change in load. This is accomplished by the method shown diagrammatically in Fig. 2, which also shows the governing mechanism. Upon the shaft G, which is driven by the turbine, are two magnetic clutches, E and F, each of which can be employed to drive a mitre gear, which, in turn, through a worm and wheel, drives the pinion K, which operates the turbine gate rod. The two magnetic clutches are actuated by currents supplied from a small dynamo, also driven from the turbine, so that it participates in any change of speed. These currents are controlled by the rocking lever, actuated by the electromagnet W, which closes contacts so as to throw in either one of the two clutches, as may be required. This solenoid is controlled by the potential of the dynamo. The latter machine is shunt-wound and operated at low magnetization, so that a small change in speed produces a great change in voltage. Moreover, the force upon the solenoid varies as the square of the voltage, so that the action upon the regulating lever will be proportional to a still higher power of the speed. If the speed of the turbine increase the controlling lever is drawn down one way, closing contacts which throw in the corresponding magnetic clutch so as to close the turbine gates. A decrease of speed of the turbine is followed by a drop in voltage of the small dynamo, which allows the controlling lever to be thrown in the opposite direction by a spring, in this way actuating the other magnetic clutch so as to open the turbine gate.

Overrunning is prevented by bringing the voltage of the dynamo back to normal before the gate has been fully adjusted. This is accomplished by means of resistance connected in series with the dynamo field, which is arranged so that it can be cut in or cut out so as to lower or raise the potential of the dynamo, as may be needed. This device gives perfect control over the voltage of the dynamo, so that any desired sensitiveness in governing may be secured.

After the turbine gate has been opened or closed, so as to bring the speed of the turbine to the proper value, the compensating valve is slowly brought to its normal position by means of a spring. A magnetic clutch placed on the gate shaft M is brought into action whenever the controlling lever is thrown in either direction. This clutch drives a rope sheave, which, through steel cables, opens or closes the compensating valve at the same time that the turbine gate is changed. To the sheave is attached a drum, over which is passed a leather band, the two ends of which are attached to a spiral spring. The band is fastened to the drum sheave. Whenever the latter is turned in one direction or the other the tension of the spring will tend to bring it back to the normal position. As this drum is carried on the rope sheave, the spring will in this way return the compensating valve slowly to its normal position, when the clutch is released by the return of the controlling lever to its normal position, the flow of water through the by-pass valve acting so as to damp the motion of the valve and cause it to turn slowly. The motion of the sheave is limited to about eighty degrees.

On the worm shaft which drives the turbine gate shaft is a hand-wheel which allows the turbine gate to be opened or closed at will. This shaft also carries a nut, on which is a contact which cuts in or out an auxiliary resistance connected in the field circuit of the dynamo. The position of this contact determines the speed at which the dynamo must run in order to give its normal voltage. In this way a certain drop in the speed of the turbine with an increase in load is brought about, a requirement for satisfactory parallel running of dynamos. This arrangement may be omitted if a constant speed be desired, or it may be reversed to effect an increase of speed with load. The hand-wheel is normally loose on the worm shaft. When it is thrown into gear, so as to turn the shaft, it automatically opens the dynamo circuit, and in this way releases all magnetic clutches. There is also a limiting switch which opens the dynamo circuit and thus releases the clutches if the turbine gates are fully opened and a movement of the governor takes place which would throw the clutches so as to attempt a further opening of the gate. By means of a third resistance in the field circuit of the dynamo a certain degree of speed adjustment may be made at will. This resistance may be placed on the station switchboard or wherever is convenient.

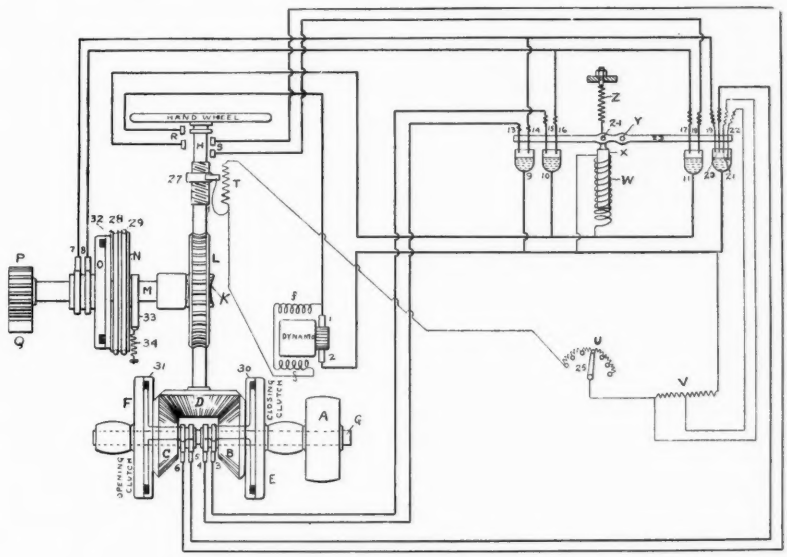


FIG. 2.—DIAGRAM OF HYDRAULIC TURBINE GOVERNOR.

Final List of Questions for the 1906 Question Box of the National Electric Light Association.

The final list of questions for the 1906 question box of the twenty-ninth convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 5 to 8, is being distributed. Mr. Paul Lüpke, the editor, 222 East State street, Trenton, N. J., is desirous of securing as complete answers as possible, and will be helped considerably if these answers are sent in at once.

Reviews of Current Engineering and Scientific Literature.

A Rapid Method of Determining the Magnetic Moment of a Bar Magnet.

A simple method of determining the magnetic moment of a bar magnet is described here by M. H. Armagnat. The magnetic field surrounding a straight bar magnet, when measured in the plane perpendicular to its centre, decreases in intensity with increasing distance from the centre of the magnet. The force at any point is given by the equation $F = \frac{M}{(l^2+x^2)^{\frac{3}{2}}}$, in which M is the magnetic moment, l the length of the magnet and x the radial distance from the axis of the magnet. If such a magnet be placed in a magnetic field and allowed to orient itself, it will place itself so that the lines due to the field pass along it, and the field immediately surrounding it will be a resultant of the original field and that due to the magnet itself. If a curve be plotted which represents the intensity of the field due to the magnet alone, this curve will represent also the intensity of the resultant field due to the magnet and the external field, if it be displaced a distance equal to the intensity of the external field. This curve will then cross the distance axis at some point, showing that at this point the force changes its direction; therefore, if a small magnet, such as a pocket compass, be placed at this point, it will behave as though there were no field there. Practically it is hard to obtain such a condition because of the length of the exploring magnet, but it is not difficult to determine the point with fair accuracy by moving the exploring magnet in one direction and in the other and noting the points at which it takes up definite positions, pointing, of course, in opposite directions. The points sought for will lie between these two positions. The distance from the centre of the magnet having been obtained in this way, the magnetic moment is given by the equation $M = Fd^3$, or $M = Hd^3$, where H is the horizontal component of the earth's magnetism. When the earth's field is employed in the test the value for H can generally be taken from physical tables for the locality where the experiment has been made. The author has used this method and finds no difficulty in determining the magnetic moment of a bar fifteen centimetres long with an accuracy of about two per cent.—*Translated and abstracted from La Revue Électrique (Paris), March 15.*

A Carbon Battery.

While experimenting some time ago with two agglomerated plates of carbon, M. A. de Geoffroy noticed that when they were laid together one upon the other and separated with a sheet of paper moistened with brine that a slight electromotive force appeared. It was further found that the upper plate was always the positive pole of the couple thus formed. The output of such a battery is, of course, very small, so that to study the phenomena more satisfactorily a battery was set up in the following way: a plate of carbon was laid in the bottom of a glass jar, which was then filled nearly full with crushed coke. Upon this layer of coke was placed a disc of felt, which was, in turn, covered with a second layer of crushed coke. A carbon rod covered with rubber tubing formed a connection with the lower plate. A second carbon rod was inserted in the upper layer of coke to form the other terminal of the battery. The arrangement thus secured was filled with brine up to about half the height of the second layer of coke. With such an arrangement it was not possible to predict at first which of the two terminals would become positive and which negative, nor to say how the battery would behave for the first few days, but after standing for some days the upper layer of coke becomes positive and the lower negative, and a potential is finally developed of about one-third volt. The battery was connected to a copper voltameter in order to measure its output, for the current was very small. After running for 112 hours it was found that copper had been deposited on the cathode to an amount indicating that the average current had been 0.0066 ampere. The battery was then allowed to stand, and the voltage, which, at the end of the run, had been about zero, rose gradually from day to day, until at the end of ten days it was back almost to the original figure. This experiment indicates that there is a true electromotive force set up in the battery and that the cell is easily polarized. A second experiment of the same character was made with a silver voltameter. This test ran for thirty-five days, during which nearly half a gramme of silver was deposited. The average current of the run was 0.00012 ampere. The cell again recovered slowly when allowed to stand. Since it had been found that changes in temperature of the original couple formed of two carbon plates did not affect the electromotive force developed, it is apparent that this is not a thermo electromotive force. Moreover, the comparatively large value for this electromotive force argues against such a conclusion. Two explanations may be offered. One is that the electromotive force is due to a residue of oxygen dissolved in the liquid, or the electromotive force is not due to the decomposition of water and its reoxidation by the atmospheric air, as had first been supposed. In this connection it is interesting to recall the old carbon battery proposed in 1884 by M. D. Tommasi, the electrodes of which were one of carbon and the other of lead peroxide. The electromotive force of the cell was about 0.7 volt, which was supposed to be due to oxidation of the carbon and a reduction of the lead, which theoretically would give about 0.85 volt. In order to determine whether the air had anything to do with the action, the cell was covered with a layer of petroleum, but this did not stop the action. It was found, however, that when the upper layer of coke was submerged in the brine that the cell ceased to give the electromotive force. It is difficult to explain why the layer of oil did not prevent the action, although it did cause the cell to polarize more quickly and to recover more slowly; but it is supposed that in this case the action was due to oxygen contained in the solution. —*Translated and abstracted from L'Éclairage Électrique (Paris), March 17.*

The Field of Electric Direct-Current Service.

In this article Mr. H. L. Abbott presents the advantages of a direct-current electric supply, taking the stand that there are situations where the alternating current is not so convenient. The enthusiasm which almost always accompanies the successful commercial development of new apparatus makes it easy at times to overlook the solid and tried advantages of established practice. These remarks apply particularly to the present time, when the alternating-current motor is making such phenomenal conquests in the great field of railway transportation. But it is well to realize what a strong grip direct current still has on many kinds of service and to remember that an engineer may sometimes prescribe a continuous-current system without being hopelessly out of date and retain one in commission without falling

from grace. The great bulk of central station business in the congested districts of large cities is handled by direct-current equipment. Even in those cases where the distance of transmission has warranted the installation of high-tension, alternating-current lines feeding substations which, in turn, have become local centres of distribution, the direct supply of energy to the consumer is largely accomplished by continuous-current circuits. It is an open question whether there is any real economy in the use of alternating-current equipment in the business districts of large cities for general power and lighting work, although, of course, many special cases arise where the transformer or the induction motor is better adapted to the work in hand. From the standpoint of a power station designer and operator it is a great advantage to have to generate only one kind of current, but in the commercial operation of a great distribution system a number of other considerations enter besides the first cost, operating efficiency and convenience of the power plant. One of the most obvious reasons for the retention of the direct-current service in the larger cities is the enormous investment which at present exists in this system. Hundreds of thousands of horse-power in motors and almost countless arc and incandescent lamps are owned by the electric supply companies or their customers in addition to the generating machinery and the distributing plant. In some of the smaller cities the managers of the electricity supply companies have reached a point where no direct current is sold outside of their stations, but in such cases generally the original investment in generators and underground lines has not been great. An important point in favor of the direct-current service is the relation existing between it and the storage battery. Aside from its use in parallel with exciters, the battery has little application in a pure alternating-current system. The regulation in voltage possible from the central generating plant or substation in a system which is characterized by direct-current distribution is probably much better than the alternating plant can provide, on the whole. Although the number of substations required can often be reduced when alternating-current is substituted for direct-current distribution, it is out of the question to do away entirely with substations and to obtain first-class regulation at a distance from centres. The substitution of transformers for rotaries or motor-generators at distributing points means a notable gain in operating efficiency and a decrease in the power-house capacity required to deliver a given amount of current at the distribution centre, provided, of course, switches are installed for disconnecting the high-tension side of the transformer when they are not in use, thus saving the core losses. A striking limitation of the alternating-current system of distribution is found in the difficulty of giving as good elevator service with it as with direct current. To the central station the elevator problem is an exceedingly important one, for in the large city the central station manager can not drive out the isolated plant unless he can guarantee to supply the best quality of elevator service as well as light and power generally. The whole question of extending alternating-current urban distribution hinges more upon the development of the single-phase motor than upon any other factor, but the question of retaining the existing direct-current distribution systems is a much broader one.—*Abstracted from Cassier's Magazine (New York) April.*

Wireless Telegraphy in German Southwest Africa.

A brief description is given here of the wireless telegraph system now being used in German Southwest Africa. At the beginning of the present Herero uprising the heliograph was made use of to a great extent for transmission of information between the various detachments and the camps. This use was not altogether successful because the heliograph can be employed only during clear weather, and, further, because unless the exact location of the troops with which communication is sought is known, there is a good deal of difficulty in getting in touch. Wireless telegraphy is, of course, free from these two difficulties. Each of the stations in Southwest Africa is arranged for two wave-lengths, which are, respectively, 800 feet and 2,400 feet. The same aerial is used in both cases. It is balanced by means of a sheet of copper gauze stretched above the surface of the ground at a height of about one metre. For the shorter wave-length this gauze has an area of about sixty-five square feet. In the second case the area is about 260 square feet. The air lines are raised to a height of 650 or 1,000 feet by balloons or kites. The balloons have a capacity of 350 cubic feet and a lifting power of about 6.6 pounds. The kites have an effective surface of about twelve square feet, so that even in light winds it is possible to economize gas. The complete equipment comprises three two-wheeled vehicles carrying the generating plant, apparatus and the stores, respectively. Each vehicle weighs about 2,200 pounds and is easily hauled by one horse or mule. The generating plant consists of a gasoline engine directly-connected to an alternator with an output of one kilowatt. Cooling water for the engine is kept in circulation by a small pump. The fuel tank contains about thirty quarts, which is sufficient to run the engine for about thirty hours without interruption. A small storage battery supplies the ignition current. A cable drum is attached to the engine which is employed for hauling in the balloon, control being maintained by means of a friction clutch. This cart also carries the counter capacities with the rods for suspending them above the ground. The second cart carries the sending and receiving apparatus. It is divided into two parts by a partition, which serves to protect the operator from personal contact with the high-pressure apparatus. The equipment consists of the usual induction coil, Leyden jars and a variable multiple subdivided spark-gap and a high-tension transformer. These are all readily accessible by means of a removable door in the side of the case. The rear section contains the Morse key and two receivers mounted on a spring-supported base. This section contains also the large receiving transformer, a coherer, and a switch for throwing in or out the counter capacities. An electrolytic detector, the telephone receiving apparatus and a light call bell are also provided. The third cart carries the balloons, the gas holders and a supply of gasoline. There are two holders, each with a capacity of about 160 cubic feet of gas at 1,800 pounds. The staff consists of four officers, four non-commissioned officers and twenty-seven men. Although the apparatus was supplied hurriedly it has been used most successfully and has maintained continuous communication. For distances not over sixty miles a recording telegraph was at first used; for distances as great as ninety miles the telephone receiver was used instead. Later on the receiver was adopted for all work. A good deal of trouble was encountered, due to wind storms, which broke the kites and tore the balloons. Although the longest fixed transmission is about 100 miles, communication has been established between points about 200 miles apart.—*Abstracted from the Electrical Review (London), March 23.*

A Plan to Erect a Municipal Power Plant at Niagara Falls, Canada.

A municipal power commission was appointed recently by a number of towns in Ontario, Canada, to investigate and report upon the question of supplying these towns with power from Niagara falls. This commission has just reported, and recommends unanimously that the towns interested cooperate in constructing a hydraulic plant on a site in Victoria Park, near the falls, and that the power there generated be distributed to the various cities which enter into the arrangement. The tentative plans contemplate erecting a plant with an output of from 60,000 to 100,000 horse-power, depending upon the number of towns which go into the scheme. They call for spending from $9,000,000 to $12,000,000 for the plant and the transmission lines. The towns which have already agreed to enter into the plan are Toronto, London, Brantford, Guelph, Stratford, Woodstock and Ingersoll. A number of other towns are favorably situated as regards the transmission lines, and some of them would doubtless join with those mentioned if the work were undertaken. If no towns except those mentioned should join the plan, it is proposed that a plant be constructed with a present output of 30,000 horse-power, but which can be increased to 60,000. If all of the towns which are well situated for receiving power from the falls should enter the plan, the station would be laid out for an ultimate output of 100,000 horse-power.

It is recommended that when the work be undertaken the cost of the installation be apportioned among the various cities, according to the power which each will utilize. With a 60,000-horse-power plant the cost to Toronto, the most important city, would be $6,265,000. With all the cities entering into the plan the cost to Toronto would be $6,216,000 only. London is the next city in importance, and the cost to it would be $1,095,000 for the smaller plant, or $945,000 for the larger plant. The other towns will bear the expense in proportion, the total cost for the smaller plant being $9,354,000 and for the larger $11,909,000. This larger plant would supply power to eighteen towns.

It is estimated that the annual expense of operating the plant would be about $371,000 for the interest and sinking fund of a 30,000-horse-power equipment. This would rise to $519,000 for the 60,000-horse-power station and to $661,000 for the 100,000-horse-power station. The corresponding figures for other charges would be $488,000, $619,000 and $752,000, making the total operating cost for the three stations considered, respectively, $859,000, $1,138,000 and $1,413,000. These figures do not allow for the cost of distribution in the cities nor for taxes.

The report of the commission states that the present net annual demand for power by the seven municipalities mentioned above which the commissioners represent amounts to 55,325 horse-power. This includes arc lighting, incandescent lighting, manufacturing, pumping, traction and other public service requirements. The commission estimates that the savings which would be effected by the plan outlined above would amount to over $1,864,000 annually. These are said to be the minimum savings to be expected. There is, however, about $4,000,000 in equipment invested in power stations which would have to be liquidated, as the plants would have to be changed to suit the new conditions, motors being introduced in place of the engines now in service. These changes would involve a certain loss of capital, which will vary according to local conditions. The amount is said to be less than the $4,000,000 mentioned. The saving of $1,864,000 is equivalent to interest at five per cent on a capital of over $37,000,000, so that, allowing for the liquidation of the existing plant, the annual saving corresponds to a net capital value of $33,000,000.

The commission submits certain tables giving the rates at which the power should be furnished to the above municipalities and to private consumers. These rates take into consideration the distance of the various towns from the power station and also the portion of the total expense which the town has borne. They vary from $21.97 at Toronto per horse-power-year for motor service for the 30,000-horse-power plant to $53.07 at London for the same service. When the capacity of the plant has reached 60,000 horse-power the corresponding figures will be $15.72 and $23.87. For the 100,000-horse-power plant they would be reduced to $14.60 for Toronto and $20.34 for London. The cost at Toronto for arc lighting per lamp is set at $42.02, $37.61 and $36.48 per lamp year for the three plants, respectively. For the other towns the rates will be higher, being greatest at Ingersoll, where they would be $72.58, $64.08 and $60.40 for the three plants, respectively. For incandescent lighting Toronto will pay 7.4 cents, 6.4 cents and 6.1 cents for the three plants. The rate at Ingersoll would be the highest for this service also, being 13.21, 11.12 and 10.23 cents per kilowatt-hour, respectively, for the three plants. One table shows the cost per horse-power per annum at the municipal switchboards of eleven towns which have not entered into the agreement as yet. This varies from $8.89 for Hamilton to $28.06 at Hespeler for one horse-power-year. The commission also gives a table showing the average steam power costs for a ten-hour service for plants of various size. This varies from $111.50 per horse-power-year for a ten-horse-power plant down to $24 for a 750-horse-power plant.

The committee then discusses the question of raising the money necessary to carry out the work. It is said that the municipal power works act provides for such undertakings. They recommend that municipal debentures be issued, to be secured by a specific first charge on bonds to be issued by the construction commissioner. In addition to this, of course, they carry the full covenant of the issuing municipalities. There will be an appreciable advance in the price they will realize if this recommendation be accepted. Application should be made to the legislature to allow the municipalities and the construction commission to vary, as may be deemed advisable, the provisions in regard to the issue of special bonds.

Election of Technical Publicity Association Officers.

At the second annual meeting and banquet of the Technical Publicity Association, held Thursday, April 5, at the Aldine Association, New York, the following officers were elected: president, F. H. Gale, General Electric Company; first vice-president, H. M. Cleaver, Niles-Bement-Pond Company; second vice-president, C. B. Morse, Ingersoll-Rand Company; secretary, Rodman Gilder, Crocker-Wheeler Company; treasurer, H. M. Davis, Sprague Electric Company. Members of executive committee—Robt. L. Winkley, Pope Manufacturing Company, and G. M. Basford, American Locomotive Works. Members election committee—C. W. Beaver, Yale & Towne Manufacturing Company; Chas. N. Manfred, H. W. Johns-Manville Company, and H. N. Kress, A. S. Cameron Steam Pump Works.

P. F. Kobbé, former president of the association, was the guest of the evening, and gave an address on the general subject of advertising. An informal discussion followed in which members and guests took part.

Exports of copper for the month of March were 16,013 tons against 21,073 tons a year ago.

The Pennsylvania Railroad's Extension to New York and Long Island—II.

The Long Island City Power Station.

STEAM GENERATING PLANT—BOILERS.

THE boiler plant for the Long Island power station consists of thirty-two Babcock & Wilcox water-tube boilers set in batteries of two boilers each, eight batteries on the first floor and eight on the second floor immediately over the former; these batteries are equally distributed on each side of the boiler plant, with a firing space between boiler fronts of about eighteen feet in width.

The boilers are designed for a working pressure of 200 pounds per square inch, and each boiler has a total effective water-heating surface of 5,243 square feet, comprised in three steam drums forty-two inches in diameter and twenty-three feet ten and five-eighths inches long and twenty-one sections of four-inch tubes eighteen feet long with twelve tubes in each section.

Besides the water-heating surface each boiler is supplied with an internal superheater consisting of two sections of tubing arranged much like a letter U lying on its side. Each superheater is capable of superheating the output of the boiler 200 degrees Fahrenheit, when operating at 200 pounds pressure, and comprises about 1,116 square feet of superheating surface.

The sections and drums composing the boilers are hung from wrought-iron beams framed into the building columns, and suspended entirely independent of the brick work, in such a manner that the brick setting is not affected by the expansion and contraction. Each battery occupies a rectangular space twenty-three feet five inches long by thirty feet six inches wide.

Provision is made for flooding the superheater when it is out of service. Each boiler is fitted with three four-inch safety valves. Each boiler has two steam openings, the main nozzle receiving steam from the superheater, and the auxiliary nozzle taking its saturated steam directly out of the tops of the boiler drums for use in the auxiliary mains that supply the small engines in various parts of the house.

The ultimate capacity of the boiler house, when finally extended, will be ninety-six boilers, of the type now installed.

STOKERS.

Each boiler is fitted with a Roney stoker. This device, like the water-tube boiler, is now so well known as hardly to need a description. It consists of an inclined series of rocking grate-bars fed at the top from a hopper extending entirely across the front of the furnace. Each stoker is 150 inches wide and has twenty-four grate bars, with a dumping grate at the bottom to drop the ashes into the ash pit. The bars are rocked by mechanical power derived from a shaft which is driven through a sprocket chain by a four and one-half by four-inch Westinghouse Standard engine, there being one engine to eight stokers. An arrangement is also provided for blowing in steam above the grates in order to disintegrate clinkers if necessary.

The contents of the ash pit are disposed of by gravity down a chute terminating over the narrow gauge railway track in the basement. At the bottom of each chute is a dumping gate for loading the cars provided for the removal of the ashes.

FLUES AND ECONOMIZERS.

The disposition of the hot gases after leaving the boilers is of particular interest. The arrangement of flues, economizers and dampers has been made so as to permit the operation of the plant on the unit system (that is, by working each set of eight boilers on one turbine) but at the same time certain features of interchangeability are incorporated, so that the flues and economizers can be interchanged and cross connected to insure the greatest capacity and highest efficiency under all conditions of operation, even though some portions of the boiler and economizer plant may be out of service. One economizer utilizes the waste heat from two batteries of boilers.

Under normal conditions the gases from the four boilers discharge into their respective sections of the main flue, then pass through the economizer directly above and into the stack, being then under the control of the main damper regulator. The first and second floor dampers and the flue partition dampers are adjustable, permitting inequalities of quantity and pressure to divide under the different economizers irrespective of the boilers in service. In case it is found necessary to isolate any economizer for cleaning and repairs, this can easily be done by closing its inlet and outlet dampers and the gases can then either be by-passed directly into the stack or divided up through the other economizers. The second floor boilers can discharge into the stack through the flues and economizers and the first floor or vice versa. All the boilers can discharge through one economizer, or all economizers can be cut out, and stacks may also be cut out so that the number of combinations possible is fully equal to any demands which extraordinary conditions may impose.

The boiler flues are of sheet steel, and are underneath the floor on which the boilers are situated. The economizers are directly behind the boilers and over the flues. Each economizer consists of fifty-six sections of ten tubes each, designed for 250 pounds pressure. The sections are designed with a special system of connections for circulating the water through them. The soot scrapers on the economizer tubes are driven by four small Westinghouse Standard engines.

The rear wall of the economizer chamber is made of vitrified asbestos air cell board, laid on in sections, so that in the event of a broken economizer tube it is not necessary to tear down any of the brick work in order to replace the section. The economizers are provided with six-inch headers, which is a larger size than usual, and each section is provided with a separate blow-off for cleaning.

By the use of these economizers the hot gases are so reduced in temperature that they enter the base of the stack at about 350 degrees.

STACKS.

There are four stacks in the power station, of which, however, only two are required for the operation of the present installed apparatus, but it was deemed advantageous to erect all four. When the station is extended the number of stacks will ultimately be six. They are built of steel, are entirely self-supporting, 275 feet in height above the base, the inside diameter of the straight portion being seventeen feet ten inches at the bottom and sixteen feet at the top. The bottom courses are flared out to a diameter of twenty-three feet. They are lined throughout with brick, which is supported at intervals of twenty feet with Z bars and rings riveted around the interior of the stack. Each stack has six openings, two in the basement for the main flues, two for the boiler flues on the first floor and two for those on the second floor. These openings are all heavily reenforced with plates and angles. The concrete base of the stack is formed solid with the monolithic building foundation and is run up

three feet above the basement floor, which gives an average height of 245 feet above the furnaces. The stack is fastened to its base by a segmental cast-iron ring twenty-three feet in diameter, held down by twenty three-inch anchor bolts, which pass through a grillage in the bottom of the concrete foundation. A ladder runs from the roof to the top of the stack and on the top is a cast-iron astragal made in eight segments with a Z-bar painting ring. Just above the boiler-house roof is a rain shield to cover the opening. In the interior of the stack are two dampers set in diaphragms for the proper diversion of the flue gases.

STEAM TURBINES.

For the initial equipment three main generating units have been installed, consisting of steam turbines direct-connected to three-phase 11,000-volt generators of the revolving-field type. The turbines are of the Westinghouse-Parsons single-flow type, rated to develop 5,500 kilowatts at 175 pounds steam pressure and twenty-seven and one-half inches vacuum, running at 750 revolutions per minute.

The bearings of the turbine are supplied with a forced circulation of oil and are also water-jacketed. At each end of the cylinder where the shaft passes through a water-seal gland is provided, which effectually prevents leakage of steam along the shaft.

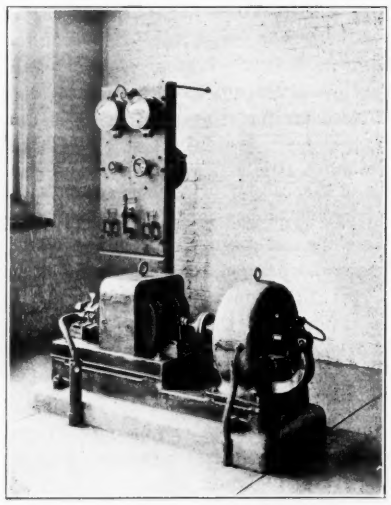
There is a large air space surrounding the cylinder for its entire length, and it is lagged with asbestos and fitted with an outside jacket of sheet steel, giving a smooth cylindrical exterior. The entire structure of the turbine and generator rests on a heavy rectangular bed-plate, which, in turn, rests on the foundation, but it is not fastened with anchor bolts.

The length of the turbo-generator unit is forty-seven feet, width thirteen feet and height fourteen feet to the top of gallery railing.

TURBINE GOVERNOR.

Unique among governors is that which controls the operation of the Westinghouse-Parsons steam turbine. A train of levers deriving its motion from worm gearing on the main shaft of the turbine continuously actuates an oscillating pilot valve, which, in turn, actuates the main admission valve (which is of the poppet type) by varying the steam pressure against a piston that lifts it. Steam therefore enters the turbine through this main poppet valve, not in a continuous blast, but in puffs, the duration of which is controlled by the amplitude of vibration of the little oscillating pilot valve. The advantages of this intermittent action of the governor are, first, that the turbine is always using boiler pressure steam no matter what the load may be; second, that the admission valve, being constantly in oscillation, has no opportunity to get stuck; and third, as the governor balls are moved in and out very slightly at every oscillation of the system of levers that is fulcrumed upon them, they are never at rest, and it is practically impossible for them to wear. The most important parts of the governor mechanism also run in oil, which ensures long life and the minimum of adjustment.

To secure the best results in parallel operation of alternating-current generators close control of engine speeds is necessary. The construction of this form of turbine governor lends itself readily to fine adjustment. Directly under the governor there is suspended a rocker carrying a weight which can be moved along it from one end to the other by a screw forming the extended shaft of a little motor carried on the rocker. This rocker is continually oscillating, receiving its motion through a vertical rod attached to the outer end of the governor lever system. The inertia of the governor leverage system is altered and its amplitude of vibration consequently changed by changing the position of the weight on the rocker, through the operation of the little motor, which can be seen at the left-hand end of the rocker. This motor is controlled by suitable switch gear located in the electrical operating gallery, so that the switchboard attendant whose duty it is to throw the machine in parallel has simply to manipulate this speed-changing device in order to attain synchronism with the generator which he is about to couple to the system.



BOOSTER FOR PREVENTING CONDENSER ELECTROLYSIS.

The turbines were built at the East Pittsburg works of the Westinghouse Machine Company.

CONDENSERS.

A separate condenser is provided for each turbine of the counter-current surface type, built by the Alberger Condenser Company, and having 20,000 square feet of cooling surface, consisting of seamless drawn-brass tubes of No. 18 standard wire gauges and one-inch outside diameter.

The condenser is placed in a large arched opening made in the turbine foundation. There is thus a marked saving in space made possible by the horizontal type of turbine, for it enables the entire condensing plant, consisting of condenser, circulating pump, dry-air pump and hot-well pump, to be compactly grouped within and about the base of the foundation.

The exhaust trunk is of cast iron, rectangular in section, well ribbed up on the outside. The outboard exhaust passes over the top of the condenser, through a thirty-six-inch relief valve, to an independent vertical thirty-six-inch exhaust pipe passing up through the roof behind the boilers.

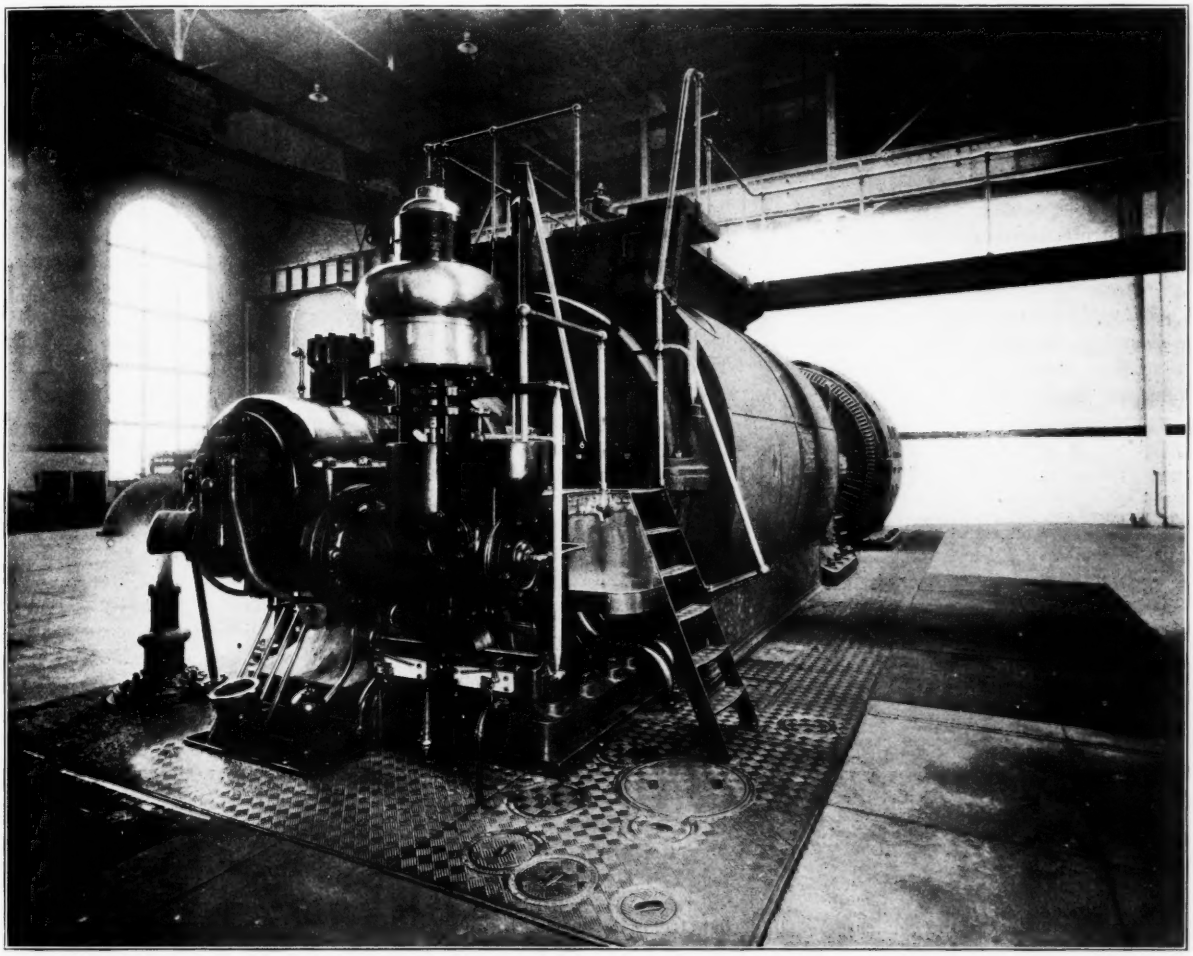
The exhaust steam enters the condenser at the bottom. The dry-air pump exhausts the vapor from the top and the water of condensation is collected from the bottom by the hot-well pump. The circulating water enters the tubes at the top, makes three passes and is discharged from the bottom of the condenser into the overflow flume directly underneath.

The intake flume is underneath the overflow, and access to its contents is made possible by a well extending past the outflow flume down to the intake flume. Condensing water is lifted from this well by a twenty-four-inch double-suction centrifugal pump made by the Morris Machine Works, capable of pumping 20,000 gallons of salt water per minute against a head of twenty feet. Each pump is driven by a 12x24x12 Westinghouse compound engine direct-connected to it. The engines are able to develop 175 horse-power at 175 pounds steam pressure at 225 revolutions per minute running non-condensing.

The condensed steam is drawn from the bottom of each condenser and discharged to the hot-well tanks in the boiler-

room basement by a four-inch centrifugal pump direct-connected to a fifteen-horsepower, 220-volt, direct-current motor running at 560 revolutions per minute. A bypass arrangement to the overflow flume is provided for discharging the condensed steam directly into the flume if desired.

Vacuum is maintained in each surface condenser by means of a horizontal steam-driven two-stage dry vacuum pump, with Corliss valves and automatic governor on the steam end and positive valve motion on the vacuum end. The vacuum cylinders and heads are water-jacketed. The steam cylinders are ten and twenty-four inches in diameter and the pump cylinders twenty-four inches in diameter, with a twenty-four-inch stroke, and their normal speed is 100 revolutions per minute. They are built by the Alberger Condenser Company.



STEAM END OF 5,500-KILOWATT TURBO-GENERATOR.

CONDENSER-TUBE PROTECTION.

A somewhat unusual feature has been introduced into this station to prevent the serious deterioration usually occurring where salt water is used for circulation of surface condensers. It is the universal experience that more or less galvanic action takes place in any event at the expense of condenser tubes, but this is often aggravated in large and important plants by the fact that the water and the body of the condenser have formed a convenient path for stray electric railway return currents getting back to their own power station some distance away through the condenser intake and the water of the harbor.

A sufficient number of voltmeter readings were taken between the river, the flume and various parts of the piping about the building and in the streets to indicate that there was at all times difference of potential enough to make trouble, although its polarity was not always the same.

The metallic connections of the power-station equipment to the city piping station are through two fourteen-inch connections to the water mains, and on account of the proximity of water mains to the trolley tracks all over the city there is a tendency for stray currents to flow into the piping of the building and thence to the condenser intake, returning through the river to the negative bus-bars of some neighboring street railway power plant. Currents flowing in this direction are certain to cause electrolytic corrosion in the condenser tubes.

The method adopted to prevent this corrosion consists first in providing a shunt circuit between the incoming water pipes and the condenser flume in order to divert as large a proportion as possible of the current from the condensers. This was done by the insertion in each water-main connection of a short piece of pipe with an insulating joint on each end of it. These short pieces of pipe were then connected to a 750,000-circular-mil cable, which was carried to the outer end of the condenser intake. Such current as may leak from the pipes to the water contained in them thus has an opportunity to get

back into the harbor without going through the piping system and the condensers.

In order to neutralize the effect of such current as might still leak past the insulating joints, a small booster generator was provided driven by a 220-volt motor, the positive pole of the booster being connected to the heavy grounded shunt cable above mentioned, the negative pole being connected to seven different points on each condenser, there being an adjustable rheostat in each of these branches of the negative circuit. This superimposed voltage can be adjusted by means of the rheostats to exactly counterbalance the natural galvanic electromotive forces due to the brass tubes, the iron shell and the circulating water, together with the stray electromotive forces from outside. With the destructive potentials so counterbalanced, the condenser is in a neutral electric state, which effectively prevents the corrosion and pitting of condenser tubes and sheets and secures a far longer life than has hitherto been possible for this very important and highly vulnerable section of the steam equipment. A little switchboard panel is provided for each condenser, with seven rheostats mounted on it, each of which is connected by a separate negative lead to a different section of each of the three condensers.

A differential voltmeter is provided which can be plugged to each of these sections of the negative circuit, there being a separate rheostat in each circuit. By adjusting the rheostats for each section it is possible to keep the potential at zero in all of them. The booster apparatus is conveniently situated in the electrical bus gallery directly under the operating gallery. The rheostat panel for each condenser is situated conveniently to it in the engine-room basement, and observations at suitable intervals enable the operating force to maintain the condensers absolutely neutral.

PIPING.

In general, the piping for the main power units in the plant was laid out to conform with the general design of the station on the lines of the unit system above referred to. In other words, the piping was so arranged that under normal conditions a given group of boilers and auxiliaries serves a single main-power unit, which is provided with suitable cross and equalizing connections between itself and the similar system of piping of the adjacent power units.

The general arrangement of the main steam piping is such that four boilers on each floor, or eight altogether, feed directly to a separate main generating unit, with a cross-connecting header located back of the first floor boilers, joining these separate feeders, and fitted with suitable stop valves.

As it is planned to use steam up to 200 pounds pressure, with 200 degrees superheat, special care had to be taken to design steam piping so as to allow ample flexibility for the excessive expansions due to these high temperatures. Long radius pipe bends were used throughout, and this arrangement has been found to furnish ample flexibility under the most exacting conditions. Full weight steam pipe with extra heavy welded steel flanges was used throughout on the main steam piping. The fittings are of special design and made of open hearth cast steel.

The valves used on this section of the work were specially designed for service under these exacting temperature tests. The valves are constructed of semi-steel throughout, with integral seats and specially designed stuffing-boxes. Gate valves were used throughout, except at the boiler nozzles, where automatic reverse current stop and check valves were provided.

The supports for the main steam piping as it crosses the boiler house to the large mains that lead to the engine room consist simply of turnbuckle rods suspended from steel work of the roof, the arrangement being such as to afford opportunity of expansion in any direction. The large vertical feeders that lead to the engine room are supported by special bracket elbow fittings at the point where they turn from the boiler room into the engine-room basement, the turbines being fed from below. The heavy manifolds are supported upon springs from steel-frame platforms that are suspended from the roof beams, the springs being introduced to ensure support from the pipe when it expands upward, these large risers being supported from the bottom. By these means the pipes are firmly supported and at the same time given all needed opportunity for expansion without setting up an unnecessary strain.

The auxiliary or saturated steam system supplies the steam required for the operation of the reciprocating steam-driven auxiliaries, including the boiler-feed pumps, circulating and dry-air pumps, stoker engines, together with all reciprocating pumps on the various water and oil systems above mentioned distributed throughout the station. These boiler connections supplying this auxiliary system are provided only with the boilers located on the engine-room side of the boiler house. This piping is also laid out on the unit system. There is an auxiliary steam line in the basement of the engine room and another in the boiler-house basement, and these are so cross-connected as to form a loop in much the same way as in the case of the boiler-feed piping. Automatic reverse current boiler stop and check valves are also provided on boiler connections of this system. All other valves being of the gate pattern.

The main outboard exhaust connection for each turbine leading above the roof of the building is thirty-six inches in diameter. This becomes operative through a horizontal relief valve hydraulically operated, the dash pot and operating gear being worked from the engine-room floor. The valve and operating mechanism is especially designed to meet the requirements of this plant, and the upper end of the atmospheric exhaust pipe is fitted with a Stein exhaust header. In connection between the turbine and condenser is a copper expansion joint to prevent strains due to expansion and contraction. There are no cross-connections between units in the main exhaust piping system.

From each condenser two six-inch dry-air pump pipes are carried to an eight-inch header located above the dry-vacuum pumps, and from this header there is an eight-inch connection to each pump. In each of the branches to pumps and condensers is placed a valve, and the headers are also subdivided by valves so that each pump with its section of header may serve a single condenser, or, if the header valves are open, it may pump air from any other condenser than that which it normally serves. The discharge from the air pumps is carried into a common header, which connects into the outboard exhaust provided for the two 2,500-kilowatt lighting units, through which it is carried to a Stein exhaust head above the roof.

The auxiliary exhaust piping is divided primarily into two systems, one receiving the exhaust from the single-acting engines which drive the condenser circulating pumps, and the other receiving the exhaust from all other auxiliary apparatus. The first system leads directly to the closed feed-water heaters in the boiler-room basement and has a cross-connection to the second system of piping, which system leads directly to the large open heater located on the first boiler-room floor, for the purpose of raising the temperatures in the "make-up" water.

The normal feed-water supply to the boilers comes from the "hot well" or storage tanks which receive their water from the main surface condensers. The water is taken from the tanks by four boiler-feed

pumps, installed in a pump room in the centre of the basement. These pumps are of the outside packed plunger, pressure type, of Epping-Carpenter make, with compound steam ends, steam cylinders fourteen and twenty-two inches in diameter, water cylinder twelve inches in diameter and twenty-four inches stroke. In case of emergency the pumps suck directly from the water supply mains. They discharge into a pipe, running around the ceiling of the pump room, making a loop which carries the discharge to the closed heaters. Each pump can discharge into either side of the loop, thus enabling the other side to be temporarily cut out for repairs if necessary.

There are two vertical coil pipe feedwater heaters, each containing 1,000 square feet of seamless copper tube heating surface, having five-sixteenths-inch steel shells sixty inches in diameter by twelve feet long, and designed for 300 pounds working pressure. These heaters are supplied with exhaust steam from the auxiliary Westinghouse engines. The exhaust from the reciprocating pumps at various parts of the basement goes to the open heater above mentioned. The heaters are situated at the west end of the pump room and are so connected to the pumps and main feed lines that they can readily be by-passed. The discharge pipes through the heaters are twelve inches in diameter.

From the closed heaters the feed water passes through risers to a loop over the first floor boilers, thence to the economizers which have been described in connection with the boilers behind which they are located. From the economizers the feed water passes into another loop, above the first floor boilers, whence it is distributed to the individual boilers.

For returning to the boilers the water of condensation in the steam pipes, two Holly gravity return systems are provided. One of them serves the main or superheated steam piping, and the other the auxiliary steam piping. The receivers of these systems are placed in the engine-room basement near the partition wall between the engine and boiler room. Connections from all points of the steam piping where water tends to collect are carried back to these receivers from which pipes are carried to the discharge chambers which are located on the wall of the house above the second tier of boilers. From this point the returning pipes drop into a return header located above the drums of the first tier of boilers and connected into them, thus returning the condensation from the pipe into these boilers.

There is also a system of water piping for general supply purposes, comprising all the plumbing, all the cooling water jackets, and turbine glands, together with hose connections and others for general use. This system is supplied by two compound-duplex piston pumps of Epping-Carpenter manufacture, with steam cylinders six and ten inches and water cylinders ten and one-quarter inches in diameter, and twelve inches stroke. These pumps are constantly operating against a head of sixty pounds pressure and each has a capacity of 500 gallons per minute.

The cooling water after being circulated through the bearings is collected and returned again to the general supply main in the power-house. This is done by means of two compound-duplex Epping-Carpenter six by ten by eight and one-half by twelve-inch pumps, each having a capacity of 200 gallons per minute.

Another auxiliary water-supply system is installed for the purpose of washing and testing the boilers. This system is served by one eight by twelve by seven and one-half-inch compound-duplex outside packed pressure type pump of Epping-Carpenter make, able to supply 250 gallons per minute at 150 pounds pressure. While normally used for supplying water for boiler washing, it is so built that full steam pressure can be turned into the low-pressure cylinder and the pump then worked under 350 pounds pressure which is used for testing the boilers after washing and repairs.

Although the entire power-station structure is absolutely fireproof, it is situated in the middle of a manufacturing district and adjacent to the water front in a position that calls for complete fire protection against outside conflagration. This is effected by an extensive system of cast-iron-flanged fire pipe line, with seven one and three-eighth-inch monitor nozzles disposed along the parapets surrounding the roof of the building, two at the middle of the coal bridge, commanding the railroad yard, and two on the coal tower itself, commanding the water front. Four Siamese hose connections are provided at the sidewalk level at the four corners of the building; and one inside the boiler house at the east end of the coal bunker, as a protection against possible fires in the bunker. This system is served by two twelve by ten by twelve brass line, 1,000-gallon Epping-Carpenter pumps installed in the southeast corner of the engine-room basement, with salt-water suction direct from the intake flume. These pumps are constantly under steam and are pumping against a head of 100 pounds, the fire-line system being fitted with a system of relief valves, all pipes and valves being properly protected from freezing, which constantly insures the immediate availability of the entire power of both pumps at any place where protection from fire may be needed.

There are three systems of distribution of lubricating oil. First of all, is that which distributes the oil to the turbine bearings and includes a storage tank eight feet in diameter by fourteen feet eight inches deep, situated in the boiler house at about the level of the coal bunker from which oil is distributed by gravity to the turbine bearings. From the bearings it is carried to a filter tank from which it is pumped automatically to the storage tank again by two 6x10x8½x12-inch compound-duplex piston pumps of Epping-Carpenter manufacture, each having a capacity of 200 gallons per minute under sixty pounds pressure. The connections of this system are all of brass pipe, to avoid all possibility of scale. The oil pumping and filter system is located in the northeast corner of the engine-room basement. The filtering plant is located in a two-story closed chamber, the upper story containing several tiers of filter pans which carry the bags through which the oil runs, the lower story containing the tank and pipe discharge connections to the oil pumps which are situated on top of the structure.

There are about 5,000 gallons of oil in this system and about ninety gallons per minute is circulated through each turbine when in operation. About twenty gallons per day is drawn off for various purposes, this including a very small loss by evaporation.

The oiling system for the crank cases of the Westinghouse engines used for the auxiliaries includes a storage tank three feet in diameter by ten feet nine inches high, which supplies by gravity a system of piping that leads to all Westinghouse reciprocating engines and allows the addition of new oil when needed. The discharge from the engine crank-cases is pumped to a filter tank and thence flows to a drain tank from which it is pumped through a system of piping leading back to the engines so that crank-case oil may be used over as often as desired, this being done by Epping-Carpenter pumps 4½x2¾ x4 inches of brass-fitted duplex piston type.

Cylinder oil for the lubrication of the cylinders of the reciprocating engines is handled by the system which includes a storage tank feeding by gravity through a system of piping that serves the lubri-

cators on all the reciprocating engines and pumps. Fresh oil is raised into this storage tank from small receiving tanks by means of compressed air.

Except in the crank-case oil return line, which is of standard weight wrought-iron pipe, all oil piping is of brass with cast-iron fittings. All sizes above four inches are fitted with cast-iron flanges into which the brass pipe is expanded.

The station is equipped with a compressed-air system for cleaning and other purposes. Air is supplied to this system by two motor-driven compressors of the Westinghouse Traction Brake Company's D-4 type of water-cooled compressors, operating from the 220-volt supply circuit. Each compressor has a capacity of fifty cubic feet of free air per minute, at 100 pounds pressure, and is controlled automatically by a pump governor.

The compressed air is used for cleaning the main and auxiliary generators, switchboard apparatus, and electrical accessories, and also in connection with the oiling system for forcing new cylinder oil and new crank-case oil into the storage tanks from which these oils are delivered to the oiling system. It is also used for an air hoist for handling oil barrels and emptying them into the receiving tank. The pressure usually carried on the system is eighty pounds per square inch.

The system is made up of standard wrought-iron pipe with extra heavy fittings and valves.

The waste from the roof leaders and the sanitary appliances runs to a connection to the city system of sewers. The drains and pumps on the basement-floor level, however, are so near the level of mean high tide that the tide trap is inserted in the outgoing sewer connection to prevent sewage backing up in the drains. At times of high tide the floor and other drainage is given an outlet to the overflow flume.

PIPE COVERING.

The non-conducting covering applied to the pipes and other heated surfaces throughout the building was furnished and put on by Keasbey & Mattison, in accordance with specifications drawn up by Westinghouse, Church Kerr & Company. That on the superheated steam pipes consists of a layer of one-inch asbestos cement and then a layer of one-inch eighty-five per cent magnesia blocks covered again with three-quarter-inch cement enclosed in a heavy canvas jacket.

The saturated steam pipes are covered with one and one-half inches of eighty-five per cent magnesia jacketed with heavy canvas. Boiler feed lines and high-pressure drips and all other auxiliary piping and heaters are also covered with eighty-five per cent magnesia in varying thicknesses. The smoke flues are jacketed first by one-inch air space and then with one-inch forty per cent magnesia overlaid with one-half-inch coat of hard finishing asbestos cement.

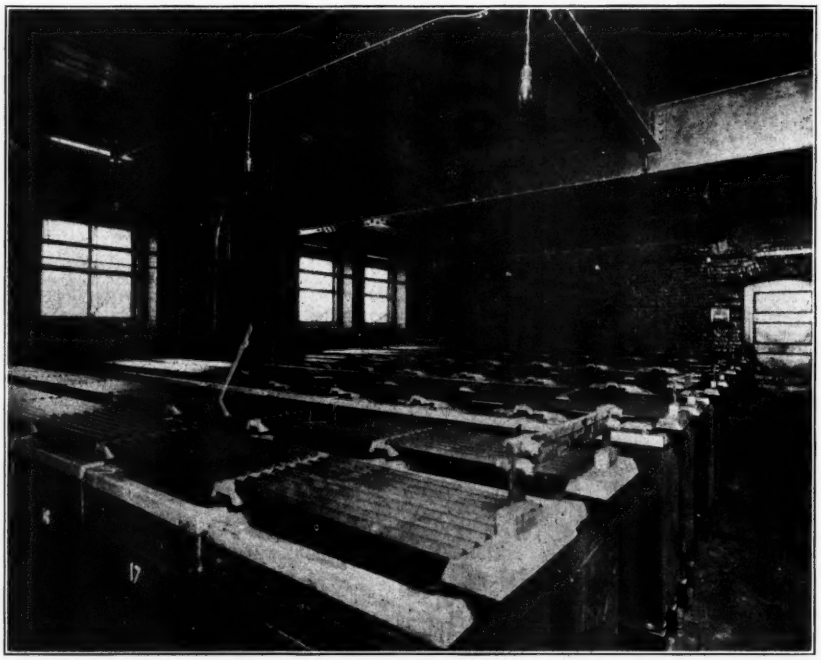
These non-conducting coverings are held by galvanized iron netting and tie wires underneath the canvas.

The covering of the flanges and fittings on the superheated steam lines was of the special sectional design so as to be readily removable. Canvas covering on pipes and other surfaces were given two coats of paint, and a general color scheme was devised for the purpose of indicating at a glance the various systems of piping. The scheme was very carefully worked out, and, as may well be imagined, it has been found of great convenience to the operating force.

All the gate valves are made by the Chapman Valve Manufacturing Company and the globe valves by the Star Brass Company.

ELECTRICAL EQUIPMENT—TURBO-GENERATORS.

The stationary armature, enclosed in a large cylindrical yoke of cast iron, consists of a ring-shaped core built up of overlapping punchings of soft sheet steel with the interior surface slotted to receive the winding, having ventilating strips inserted at suitable intervals to form passages for the free circulation of air through the core and winding. The coils are wound with copper wire and, as is usual with very large generators, the coils were built into the slots after the armature frames and cores were permanently in position on the bedplates. The coils are securely held in the slots by retaining wedges of hard fibre, fitted into grooves formed in the armature teeth. The ends of the coils where they project beyond the ends of the laminated core are protected by large perforated cast-iron flanges completely enclosing the opposite ends of the armature. The machines are "star-wound," i. e., the three sets of armature coils needed for the generation of three-phase alternating current are all connected to one point, called the "neutral," and the neutral points of the three machines are connected to one neutral bus, which is permanently grounded through a resistance.



STORAGE BATTERY FOR EXCITER SYSTEM.

The revolving field consists of a four-pole structure formed out of solid steel disks, milled to receive the winding. It is six feet eight and one-quarter inches in diameter, and about six feet long. The field coils are wound with heavy copper straps embedded in slots and retained by heavy bronze wedges. Ventilating ducts are provided in the core which enables the revolving field to draw an abundant supply of air through its interior by a sort of fanning motion, which also aids in reducing the temperature of the stationary armature.

The core is pressed on and keyed to a

shaft of nickel-steel, nineteen and three-quarter inches in diameter, and running in bearings fifteen inches in diameter, through which there is a forced circulation of oil. The field is separately excited at 220-volts, the exciting current being delivered to the winding through a two-ring collector by means of sliding carbon brushes.

These generators are each guaranteed to deliver 289 amperes per terminal at 11,000-volts, and eighty to 100 per cent power factor for twenty-four hours continuously, with a rise in temperature not to exceed thirty-five degrees centigrade; and a fifty per cent greater current for two hours with a rise not exceeding fifty-five degrees centigrade.

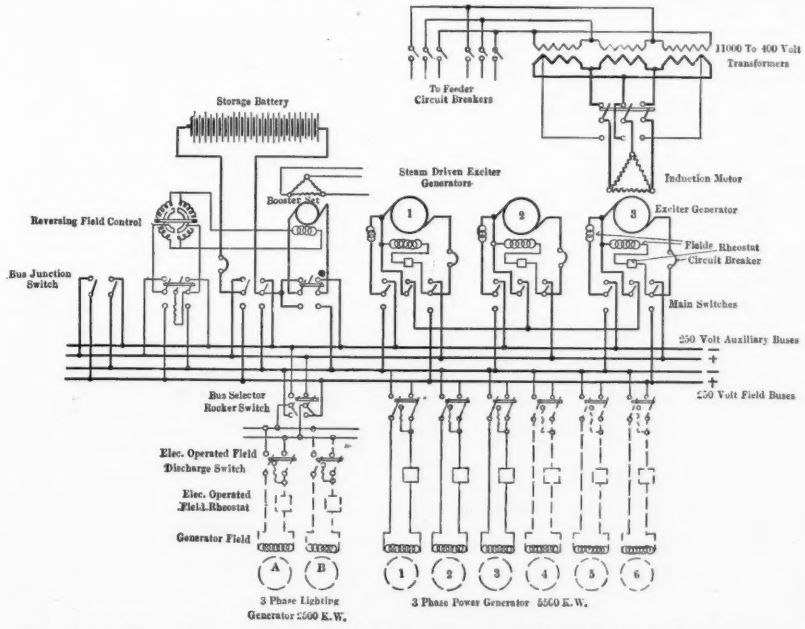


DIAGRAM OF LOW-TENSION MAIN CIRCUITS FOR PRESENT HALF STATION, LONG ISLAND CITY POWER STATION.

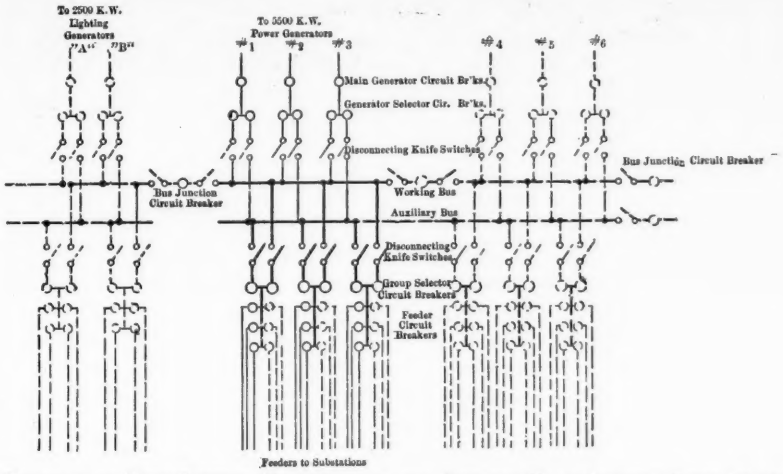


DIAGRAM OF HIGH-TENSION MAIN CIRCUITS FOR PRESENT HALF STATION, LONG ISLAND CITY POWER STATION.

EXCITERS.

Three separate sources are provided for exciting the fields of the main generators, viz., the two steam-driven exciters, one motor-driven exciter, and a storage battery. These are designed to give direct current at from 180 to 120 volts.

The steam-driven engine units each consist of a Westinghouse-Parsons steam turbine directly coupled to a 200-kilowatt direct-current turbo-generator, designed to run at 1,800 revolutions per minute.

These turbines are of the same general type as the main units and are designed to run either condensing or non-condensing, with 175 pounds steam pressure and superheat up to 200 degrees. Besides a connection to the superheated steam supply they are also connected to the auxiliary steam main that supplies saturated steam. They are arranged so that they can be exhausted into one of the large condensers or, when running non-condensing, into the auxiliary exhaust mains, passing the exhaust steam either to the feeed-water heaters or to a separate outboard exhaust riser.

The exciters are located near the southwest corner of the main floor.

The motor-driven exciter, also of 200-kilowatt capacity, is driven by a 290-horsepower, three-phase, 440-volt induction motor, both motor and generator being mounted on the same shaft, bearings and bedplate. This motor-driven exciter is located in the operating gallery. The three-phase motor derives its current from three 175-kilowatt oil-insulated self-cooling transformers located in the basement of the electrical gallery.

STORAGE BATTERY.

The storage battery is intended mainly as an absolutely reliable source of supply of the exciter bus system and the other more important auxiliaries. It is installed in a specially-arranged room in the engine-room basement and consists of 110 cells, each containing seven plates of the type "R" chloride accumulator manufactured by the Electric Storage Battery Company. The tanks are built large enough to ultimately contain eleven plates. This battery has a discharge rate of 366 amperes for one hour, and is controlled from the operating gallery. It is normally kept floating across the excitation bus. In order to charge the battery a 12.5-kilowatt booster, driven by a fifteen-horsepower induction motor, is located in the operating gallery next to the motor-driven exciter above mentioned.

SWITCHBOARD APPARATUS.

The generators are designed to run in parallel on either of two sets of main busbars, called the "working" and the "auxiliary" bus, only one set of which is generally in use. The general plan of the main wiring is quite simple and is shown in diagrams herewith. For the sake of simplicity, the three conductors forming a three-phase circuit or connection are shown in the diagram as one conductor.

The switches for the outgoing feeders are arranged in groups of six (three only of each group being installed at present), the said feeders being tapped from an intermediate or "group" bus. In order to distribute current to the feeders, therefore, it is first necessary to connect a group bus to either the working or the auxiliary bus, and this is done by providing each group with two selector circuit breakers, one for each of the two sets of main busbars. Thus, any generator, or any group

of feeders, can be connected at will to either set of main bus-bars.

The cables are run through the turbine foundation into the basement (where taps are taken off for the generator potential transformers, whence small wire leads run in conduits to the instrument board in the operating gallery) then to main generator circuit-breakers which are placed on the feeder gallery next above the basement, with their backs to the engine-room columns.

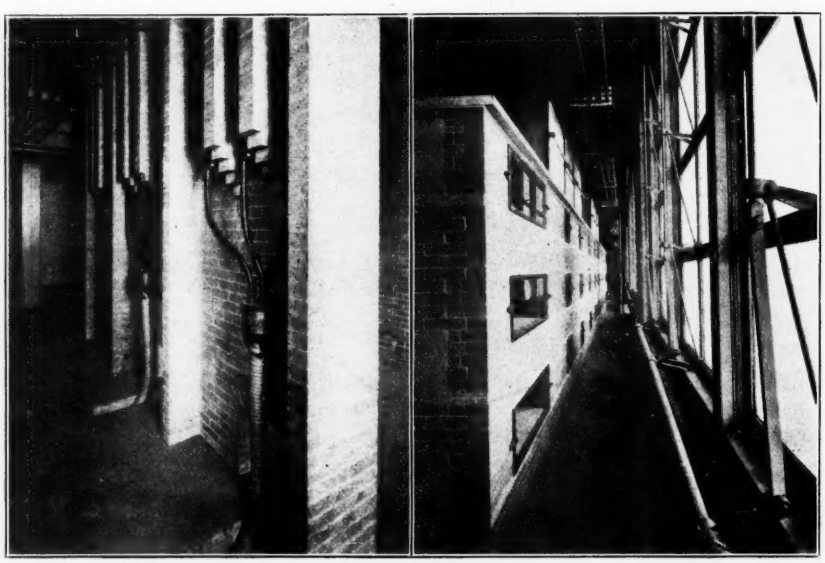
The disposition of the main and auxiliary bus-bars, and the arrangement of the feeder switches is such as to tend to combine excellent mechanical alignment of the apparatus with economy of material and flexibility of operation.

The three bus-bars of the working bus are disposed in the three-story bus structure of brick and alberene stone along the north side of the gallery, the auxiliary bus being disposed in a similar structure along the south side and directly opposite the main bus. Ranged along the inner sides of these bus structures, and facing each other, are two lines of Westinghouse type "C" oil circuit-breakers. The two smaller breakers on either line directly opposite each other are the generator selector circuit-breakers, and the two larger ones are the feeder group selector breakers. These successive pairs of feeder selector switches are joined underneath the floor by group bus-bars, and there being a selector switch at each end of this group bus-bar, the said group bus can be joined to either the main or auxiliary station bus. The main generator switches are connected to similar sets of cross-connecting bus-bars joining the generator selector switches, thus enabling any generator to be thrown in on either set of bus-bars by closing the proper selector switch. The feeders are tapped from the group bus joining two opposite feeder selector switches, six feeders being tapped on to each auxiliary group bus, and each feeder having its separate circuit-breaker. The feeder circuit-breakers are therefore installed in groups of six, three of each group being now installed, the remaining three being omitted until future completion of the equipment.

All of the circuit-breakers are Westinghouse type "C" oil switches, with remote electrical control, worked from the main operating gallery on the upper floor. The main generator circuit-breakers are of 600 amperes each, the general selector-breakers of 600 amperes capacity, the feeder group selectors of 1,200 amperes capacity, and the feeder switches of 600 amperes capacity. The generator switches are four-pole, in order to accommodate an extra connection to the neutral point of the generator winding and a neutral bus which is grounded. All the other oil switches are three-pole.

Some of the features of these oil switches are worthy of note. There are two stationary contacts per pole, one for the incoming and the other for the outgoing leads of the same phase, each contact being mounted in a large porcelain insulator, the leads being brought out at the rear of the switch structure. The circuit is established between these two stationary contacts by raising into contact with them a bridging piece which is immersed in an oil bath, and is held against the contacts by mechanism operating against the force of gravity. The open position of the switch is therefore maintained by gravity, resulting in the maximum degree of safety. All live parts are submerged in oil, the quantity of which is at the same time relatively small. The opening and closing gear is a simple-parallel motion system, which is drawn up into the closed position by a closing solenoid and held there by a toggle joint. The opening of the switch is accomplished by energizing the circuit of the opening solenoid, with the result that the switch is quickly opened by gravity, tension springs being provided to take up the shock of the fall. The arcing contacts are located near the surface of the oil instead of at the bottom of the oil receptacle, thus insuring freedom from deposits of carbonized particles or other impurities at the points of contact.

Each pole of the circuit-breaker is enclosed in a separate fireproof chamber of brick, capped with a slab of alberene stone upon which the operating gear is mounted. The contact piece is carried on a substantial wooden rod which, together with the partitions formed by the lining of the tank, makes an effective barrier between the two terminals of each pole when the circuit is open. The oil tanks are of sheet metal, of a type of construction that insures absolute immunity from leakage of oil, and are insulated from the circuit. As is usual in this type of switch, the compartments are closed at the rear by the brick structure, while the front of each compartment is enclosed by a cover of asbestos lumber held in place by eccentric clamps, thus facilitating quick and easy access to the parts. These switches are all electrically operated through solenoids actuated by current received from the auxiliary bus through controllers on the switchboard panels, as will be described later. The brick work of the oil switch structures is uniform with that of the bus structure, all being built of pressed yellow brick with caps of alberene stone.



HIGH-TENSION FEEDER CABLES IN BASEMENT, ENTERING CONDUITS. BUS GALLERY, SHOWING BUS-BAR STRUCTURE AND WINDOW-OPENING DEVICE.

Beside the oil switches there are also installed disconnecting hook-type switches, to be opened and closed by hand, for isolating various parts of the system of connections when not in use, or while being inspected. These are mounted on heavy porcelain pillars placed in small compartments built into the brick bus structure.

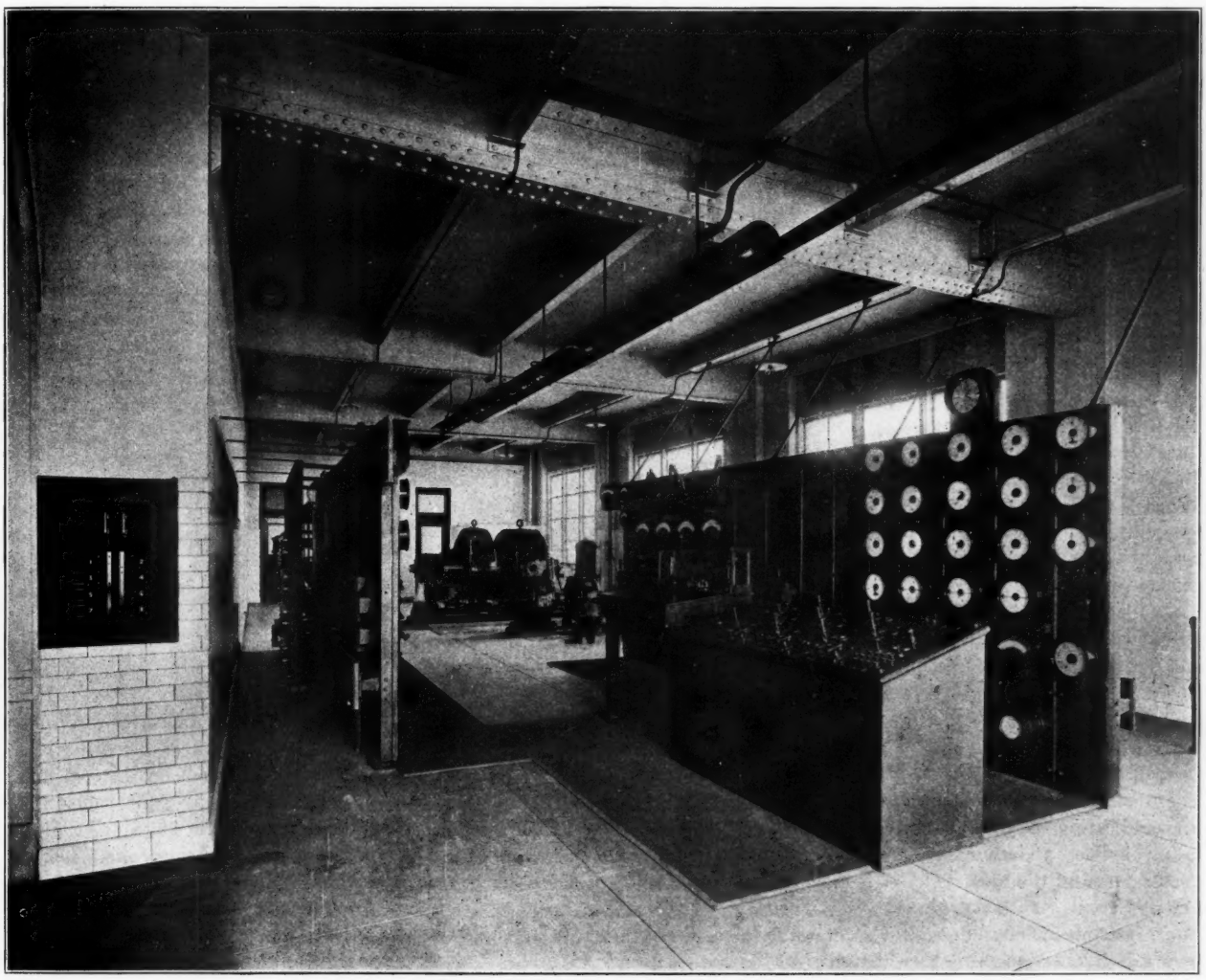
In order to get indications of the voltage across the main bus-bars, bus potential transformers are provided, mounted in brick and alberene stone compartments on

top of the bus structure. Leads from these transformers run to the instrument board in the operating gallery.

The buses themselves are composed of copper bars three inches by one-quarter inch, resting on heavy porcelain pillars, each in its own compartment of the bus structure, and entirely isolated from the other two. The main connections between the bus-bars and all the main, generator, selector, and feeder switches are of heavy copper rods, carried on porcelain insulators within brick compartments or "septums," to secure complete isolation of each conductor from all the others. These septums are noticeable in the plan of the feeder gallery, being shown on the back of each of the feeder and generator switch structures.

From the feeder circuit-breakers on the feeder gallery the separate cables pass down through the floor, still in brick septums, to a few feet below the basement floor level, where they are spliced to the conductors of the three-phase cables, which are properly insulated and lead-covered and pass into the outgoing ducts, which are laid in the floor of the basement gallery. Thence they are conducted to the distributing manhole at the commencement of the conduit line leading toward the substations.

The connections between the main generator switches, the bus-bars and selector switches and feeder circuit-breakers, are all of heavy copper bars or rods, mounted upon porcelain pillars. Bars and connectors of opposite polarity are separated by barriers or partitions of alberene stone, insuring absolute freedom from short circuit in this extremely important part of the installation. The enoromous amounts of energy developed in the power-house of this size are such as to make an absolute isolation of all main and bus connections a matter of paramount importance. The main conductors, separate as they are by partitions and carried on heavy porcelain insulators, need no other insulating covering.



Electrical Operating Gallery.

ELECTRICAL-CONTROL APPARATUS.

The above-described system of switches, bus-bars and regulating or other auxiliary apparatus is all controlled from the operating room at the east end of the third or operating gallery. This location at the east end of the present engine room will be opposite the centre of the completed engine room when the building is extended to accommodate the final installation. This gallery is about thirteen feet above the main engine-room floor, and projecting from the generating room is an overhanging observation balcony that gives a good view of the whole engine room. Mutual intelligence for the proper operation of the turbines and the controlling switches is commonly interchanged between the engine-room floor and the operating gallery

by means of a system of visual signals. The control apparatus consists of the following:

(*a*) Generator control bench.

(*b*) Generator instrument board, directly in front of the bench.

(*c*) Feeder control board.

(*d*) Exciter switchboard.

(*e*) Auxiliary switchboard.

The panels are of marble, and all panels and the metal fittings, switches and instrument cases have a dead black finish. The generator control bench resembles a low desk with an inclined top, and accommodates three sets of operating handles for the generator main switches and selector switches, one set for each unit and two sets for bus junction switches, which divide the main bus into sections. The apparatus on each generator panel of this desk consists of the following:

Controller for main generator circuit-breaker.

Two controllers for generator selector breakers.

Controller for turbine governor.

Controller for field switch.

Controller for field rheostat.

Three sets of indicating lamps for the main switch and two selector switches.

Two synchronizing receptacles.

Directly opposite each generator panel on the desk is a vertical panel in the generator instrument board. Beginning at the top the instruments on this panel are as follows:

Alternating-current voltmeter.

Alternating-current ammeter.

Indicating wattmeter.

Power-factor meter.

Direct-current field ammeter.

Integrating wattmeter.

There is also a synchronizing lamp and a lamp indicating the position of the field rheostat, besides an illuminating visual indicator forming the return signal from the engine room.

These instruments are all operated from current derived from shunt potential transformers and series transformers, suitably located in the leads from each machine. On the narrow panel to the left of the three-generator instrument panels now installed are mounted, beginning at the top, three alternating-current voltmeters, giving bus potential on each leg of the circuit, and a frequency meter. There are also two synchronizing lamps on this panel, one for each bus. On the bus junction panel at the right-hand end of the instrument board are mounted a differential alternating-current voltmeter, two synchroscopes with plug receptacles, two synchronizing lamps and an alternating-current ammeter to indicate the current in the grounded neutral bus from the generators.

The feeder switchboard consists of three vertical panels, each containing apparatus for the control of six feeders and two feeder-group selector switches, one of the latter running to each bus and enabling the group of feeders on that panel to be put on either bus at will. Each of the three panels is at present equipped, however, with only three sets of feeder-control apparatus, space being left for the remaining three when the installation is completed. The complete outfit of instruments on a completed feeder panel designed for six feeders is as follows:

Six alternating-current ammeters.

Six controllers for feeder circuit-breakers, with two indicating lamps for each one.

Two controllers for the group selector circuit-breakers, having two indicating lamps each.

The exciter switchboard is placed to the left of the generator instrument board with several blank panels intervening. It is designed to control the output of two steam exciters, three motor-driven exciters (of which only one is now installed) and the storage battery, which is provided as a relay for excitation and other important auxiliary purposes. It is fitted with two sets of bus-bars, one normally used for generator excitation only and the other for the station lighting and auxiliary apparatus.

The direct-current exciter generator panels are of the usual standard type of generator panel, but fitted with double-throw switches to supply either the exciting or auxiliary buses. Upon the battery panel are mounted all the necessary switches, rheostats and other devices for controlling the motor-driven booster, whose function is to charge the storage battery. There is also a panel controlling the motor of the electric-driven exciter set.

The generator rheostats are mounted in a structural steel framework directly underneath the operating bench on the second or bus gallery. The rheostat proper consists of a series of cast-iron grids set in an iron frame. The face-plate is mounted on a marble slab and the contact arm is operated by means of a little direct-current motor receiving current from the 220-volt auxiliary bus and controlled from an operating handle on the generator panel. Reference to the photograph shows another panel mounted directly above the rheostat face-plate, upon which is mounted an electrically operated main field switch, worked from the field switch controller handle on the generator panel.

The brackets supporting the 220-volt exciter and auxiliary buses are mounted on porcelain insulators carried on the steel framework directly over the generator rheostats and directly underneath the exciter switchboard.

A separate auxiliary switchboard controls the supply to all the various direct-current motors and the lighting system throughout the station, and from it is also supplied the current required for electrically operating the above-described generator selector and feeder oil switches whether automatic or not. This switchboard consists of four panels, and its 220-volt bus-bars are connected directly to the auxiliary buses shown under the exciter switchboard. The following list of circuits gives a good idea of the extent to which electrical auxiliaries are used in the station. Switches are mounted on the board controlling the following circuits: telpherage system for disposal of ashes; motor for operating the floating bridges in the ferry house; sump pump motors; boiler-room elevator; hot-well pump motors; passenger elevators for offices; machine shop; engine-room crane; two motor-driven compressors for air cleaning, and the motor for driving the booster preventing electrolysis. There are also nine separate lighting circuits for operating 220-volt incandescent lamps in the engine room and boiler room and for supplying current throughout the entire power plant building, and a rotary balancer through which is operated a three-wire system for the 110-volt arc lamps in the engine room and boiler room and on the coal and ash towers. Two of the four panels are devoted to the straight 220-volt incandescent lighting and motor circuits. The other two are devoted to the control of the rotary balancer and the three-wire arc lighting system.

On the bus gallery and directly underneath the auxiliary board is located a set of small panels, on which are mounted the alternating-current relays which control the automatic circuit-breakers in the main power system.

Independent manual control is effected from the main switchboard by simply closing the 220-volt solenoid circuit by a switch that is in parallel with the automatic alternating-current relay.

All the outgoing feeder and main generator switches are fitted with both kinds of control, but all the selector switches have manual control only.

The indicating lamps for each switch

controller are mounted underneath bench and indicate when lighted through different colored lenses set flush with top of bench. Auxiliary contacts on the oil switches light one or other of the lamps depending on whether switch is open or closed, so that the operator receives a positive return signal when the switch mechanism has completed the infended movement. The lamp indication of course changes, and a gong rings when a switch opens automatically from the protecting devices described later.

It might also be noted that the generator selector switches are interlocked through the synchronizing plug, so that a generator selector switch can not be closed to either bus unless the synchronizing plug is in place and the synchronizing devices record the condition of phase relation.

CABLES AND WIRES.

The main generator cables are of the single conductor type, with four leads to each machine, each of 600,000 circular mils, insulated with varnished cambric ten-thirty-seconds of an inch thick, protected on the outside with double braiding. Between the group selector switches and the outgoing feeder buses each lead is of 1,318,000 circular mils cable. Between the feeder switches and the end bells of the three-conductor cables that lead to the outgoing circuits the cables are of 250,000 circular mils. Between the feeder switches and the transformers that supply the motor-generator exciter set leads are 73,000 circular mils. The main grounded neutral lead connecting all the generators to the neutral resistance is of 600,000 circular mils. All these cables are provided with ten-thirty-seconds inches of varnished cambric insulation with a double protective braiding.

The principal low-tension cables are as follows: to the generator fields, 217,000 circular mils. From the exciter transformers to the induction motors driving the exciter sets 500,000 circular mils in each lead. Between all exciters and the exciter switchboard, 1,500,000 circular mils in each lead. Exciter field connections are 28,600 circular mils. The storage battery is connected to the exciter bus by two leads of 1,000,000 circular mils. The connections of the charging booster of the storage battery consist of three 71,000-circular-mil cables to the motor and two 500,000-circular-mil cables from the generator.

The low-tension cables are provided with insulating covering of four-thirty-seconds-inch of varnished cambric insulation for the larger sizes and three-thirty-seconds of an inch for the smaller sizes, this being covered with a double layer of protective braiding.

None of the power-house cables, either high or low tension, are lead-covered. The varnish cambric insulation of the cables, which were manufactured by the General Electric Company, is guaranteed to be sufficient for the working pressures adopted without the necessity of sheathing it with a continuous waterproof covering of lead under the conditions that prevail in this power station, the ducts being so constructed that there is no possibility of moisture collecting in any point of the duct system.

The feeder cables leading to the high-tension transmission system are of the three-conductor type. Each conductor is of 250,000 circular mils and is wrapped with a layer of paper insulation seven-thirty-seconds of an inch thick. The three insulating strands when twisted into one cable are then surrounded with an additional insulating wrapping seven-thirty-seconds of an inch thick and the interstices also fitted with the same material. The whole is enclosed in lead-sheath nine-sixty-fourths of an inch thick.

These cables leave the power station through ducts laid in the floor of the basement gallery, which lead to a manhole directly outside of the building.

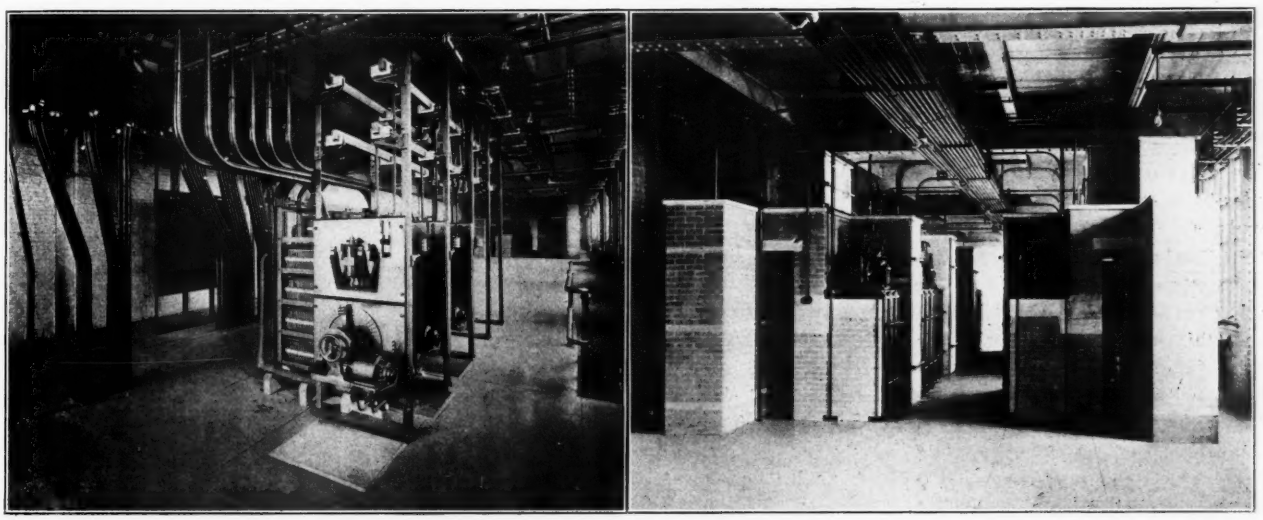
Each high-tension cable is provided with end bells of spun brass, seven and three-quarters inches in diameter and about five inches deep, sweated to the end of the lead sheath of the cable and filled with insulating compound.

The outgoing feeder cables, between the power stations and the lightning arrester house at Dutchkills street, about one and one-eighth miles distant, where the transmission system changes from underground to overhead, were furnished, drawn into the ducts and connected up complete with end bells by the General Electric Company.

After installation the cables successfully withstood the prescribed test of 30,000 volts applied continuously for a period of thirty minutes.

AUXILIARY AND CONTROL WIRING.

The general use of the distant control type of switch for the main power circuits required the installation of a great deal of control wiring between the switches and the operating board. The potential and current transformers in the main generator and feed circuits, together with the



GENERAL VIEW OF BUS GALLERY SHOWING MAIN GENERATOR AND RHEOSTATS AND AUXILIARY WIRING.
BUS GALLERY SHOWING OIL SWITCHES AND HIGH-TENSION SWITCH CHAMBERS.

signaling devices on the engines, also had to be connected to the indicating instruments on the various panels. This system of wiring was all run in "loricated" iron pipe conduits between the operating switchboard and the various pieces of apparatus. The leads for the station lighting and motor circuits were also run in conduits.

The 220-volt wiring throughout the power-house between the auxiliary switchboard and the lamps and motors is all run with various sizes of rubber-insulated and braided cable.

ENGINE-ROOM SIGNALS.

A very complete system of signals for intercommunication between engineman and electrical operator has been installed, which consists of a number of illuminated signals grouped together and located at a point visible from all parts of the engine room. These are worked from the operating gallery after the engineman's attention has been obtained by means of a whistle signal. A system of return signals operated from the engine-room floor and showing in the operating gallery enables the engineman to show the electrical operator that his signals have been understood, and the two systems together supply all necessary communication between the two operating floors. A large synchroscope, visible from all parts of the engine room, has been installed, so that by watching it the engineman is informed as the generator approaches synchronism, and is switched into service. The large letters and figures are illuminated from behind by incandescent lamps, which are lighted when the proper contact keys are pressed by the electrical operator. A corresponding set of keys at each turbine enable the engineman to light the answering signals on the instrument panel in the operating gallery.

Suspended from the large signal board is a load indicator, by means of which the engine-room forces are notified regarding the condition and tendency of the station load. This is actuated by an electric circuit manually operated by the main switchboard attendant. Other load indicators of the same type are also located in the upper and lower boiler rooms for the same purpose.

LIGHTING AND HEATING.

The lighting for the station is done by arc lamps for general illumination and incandescents for detail illumination. There are seventy-two Westinghouse 110-volt, direct-current enclosed arc lamps installed, running from the auxiliary switchboard in the manner described in the previous section. There are about 1,220 sixteen-candle-power, 220-volt incandescent lamps supplemented by about 150 special receptacles for the use of extension-plug connections to facilitate inspection and repair of machinery. The wiring for these lamps is carried throughout the building in iron conduits, with the most approved type of junction cut-out boxes and safety devices.

The heating of the electrical galleries and offices is accomplished by means of a direct system of low-pressure direct-steam pipe coils, amounting altogether to about 3,300 square feet of radiating surface. It is supplied by live steam, working through a reducing valve.

HOISTING MACHINERY.

The traveling crane spanning the engine room has a capacity of fifty-five tons and a span of sixty-four feet. It is of the double trolley type with a hoisting and a trolley motor on each trolley, besides the main motor which propels the entire crane. These motors are all operated from the 220-volt circuit. The crane was built by the Morgan Engineering Company. The hoisting trolleys are geared for both slow and rapid hoisting. Steel wire hoisting ropes are used throughout.

There are two elevators installed, one of them being a passenger elevator for serving the offices and electrical galleries and the other a combination freight and passenger elevator in the boiler house, running from the basement to the top of the coal bin. These elevators were made by the Marine Engine and Machine Company, and are all of the electrically controlled type, operated from a 220-volt circuit. They are driven by motors capable of handling live load of 1,800 pounds at 200 feet per minute and are fully equipped with safety devices. The elevator in the boiler house is arranged for automatic-button control.

MACHINE SHOP.

The machine tool equipment is provided to facilitate light repairs. The space set apart for this machine shop is on the topmost floor on the north side of the building directly over the electrical operating gallery.

The equipment consists of a portable Buffalo forge and anvil; a pipe-threading machine capable of handling pipe up to twelve inches; a bolt-cutting machine with bolt and pipe dies up to two inches; a sixteen-inch swing engine lathe with an eight-foot bed, and another lathe of thirty-inch swing, with a sixteen-foot bed. There are also a 30-inch by 30-inch by 8-foot planer, a twenty-inch shaper, a forty-eight-inch radial drill press, a light-speed lathe with a four-foot bed, a sensitive drill, a wet and dry grinder, besides an ordinary grindstone and a hack-saw machine.

The foregoing machinery is arranged in two groups, driven by a line shaft which extends over both groups, but is subdivided at its centre by a clutch coupling. Two fifteen-horse-power type C Westinghouse 400-volt, three-phase induction motors are coupled to the shaft, there being one at each end, which can thus drive a part of the machinery without making it necessary to run all the shafting.

A swinging jib crane with a two-ton Sprague electric hoist enables heavy pieces to be lifted into the machine shop from the engine-room floor.

CONCLUSION.

The first work of clearing the site began on September 15, 1903, and the excavation on October 20.

The first turbine was started January 16, 1905; the high-tension current first turned into the transmission lines April 27, 1905. Current was furnished for testing cars on May 13, and on July 26, 1905, the line between Flatbush terminal and Rockaway Park, the first section of the Long Island Railroad to use the new motive power, was permanently changed from steam to electrical operation.

The station was planned and built by Westinghouse, Church, Kerr & Company, engineers for the Pennsylvania, New York & Long Island Railroad Company, which is the organization through which the Pennsylvania Railroad is carrying on its New York extension work. The design and construction were under the charge of Mr. George Gibbs, chief engineer of electric traction of the road, and under the general supervision of the mechanical and electrical advisory committee—New York extension—a committee composed of officers of the Pennsylvania Railroad Company.

Niagara Falls Water Power.

The Ottawa Board of Trade adopted a resolution at a recent meeting declaring that the Canadian government should not enter into any arrangement that would interfere with the right of Canada to develop water power at Niagara falls, or at any other point along the international boundary. As an excuse for that extraordinary course Consul-General Foster states that the resolution declares that "in view of the fact that the Province of Ontario is largely dependent upon foreign coal for industrial and domestic purposes" it should develop its water power. The resolution also called on the Canadian government to enact legislation to prohibit manufacturers of electric power in Canada from selling and transporting the same across the border under any contract not terminable within one year.

CARE AND MAINTENANCE OF EQUIPMENT.[1]

BY R. A. WALKER, IOWA FALLS, IOWA.

While we are discussing the larger things that at present concern us, such as "district and state organization" and "tactics of the opposition," etc., it behooves us not to forget the things at home that are going to make permanent organization possible and our fighting methods successful; that is the kind of service that we are giving, a thing which the "care and maintenance of our equipment" has largely to do. I will take the liberty of covering a large portion of plant equipment in a general way and in the manner that it affects us before the public and also somewhat as to detail and as to method.

Care must start at the beginning in this industry and continue throughout the construction and operation of the plants. Maintenance must not be taken to mean, entirely, the replacing or repairing of something that has broken or given way, causing the interruption in the service, but in the better sense the anticipation of these troubles and the remedying of them before they actually occur. From the moment that a plant is constructed deterioration begins. And this can not be taken care of by allowing it to go unheeded the allotted ten to fourteen years, but to ensure an efficient and dependable service must be as near as possible continuously maintained at the same standard as the original structure. In no other line of business is that old adage that "a stitch in time saves nine," so true as in the maintenance of telephone properties. Often the giving way of a single guy or corner causes poles and leads to fall like dominoes, destroying more in a few moments' time than can be overcome in weeks. Maintenance of to-day must be of a much higher standard than in times past. Then we might have expected the average subscriber to think that "morning zephyrs" and "slight dews" would interrupt their service, but now the public refuses to "insulate themselves with that film of kindly stupidity" and demand service almost absolutely continuous, prompt and efficient. In order that fine apparatus shall deteriorate slowly, do its work properly and positively, it must be treated with the utmost care and attention.

In this discussion I wish to divide the portions into office equipment, cables and aerial lines and instruments.

Office equipment consisting of switchboards, racks and protection, and the connecting cables.

[1] Presented at the recent meeting of the Iowa Telephone Association.

Switchboards are all of a more or less delicate nature and demand the maximum of care and attention. At no point are we so liable to have single cases of trouble multiplied as in the cord circuits and trunking devices on the board. To cite the many cases that present themselves and their troubles in detail would cover volumes of space and a great portion of time, so they will be omitted here, except to caution that as the switching apparatus forms the central link in the system we must give it prompt and immediate attention and "keep everlastingly at it."

Complete and thorough periodic tests should be inaugurated, so that faults may be immediately located and repaired. Forms covering statement of all tests to be made and places for reports, with instruction, will help materially in securing the best results. Cleanliness in switchboard and rack rooms, the elimination of dust and dirt, go a long way toward minimizing troubles, such as poor contacts, cross talk and kindred ailments.

Office cables, whether dry core or paraffined, take up moisture very easily, causing induction troubles, if nothing more serious. To prevent this the original installation should be made in a building or rooms where an even dry temperature can be maintained and cables kept from the floor where moisture might collect or become damp from water used in mopping, etc. It is necessary to boil these cables with beeswax and paraffine, or otherwise drive out the moisture when they become damp.

Protection—It is necessary that the office equipment be properly protected from both lightning and foreign currents. On small boards and in small places where the liability of crosses with electric light or trolley wires is small, ordinary Postal or Western Union type fuses are used for the latter and carbon block for the lightning. Care should be taken to ensure proper grounding of the arrester bus, also that it is not made through cable sheaths or other than the main exchange ground. Racks should be wired with a fireproofed wire and be kept free from dirt and moisture.

Cables, while furnishing a convenient and reliable method of carrying a large number of lines, must be the more thoroughly watched and cared for. When properly cared for cables deteriorate slowly, but may under adverse conditions become useless in a very short period of time. The most common cause for trouble is due to holes in the sheath and is caused in many ways. Heavy currents often cause burning of holes, but this may be overcome when the current is on sheath or messenger by hanging the cables on Marlin hooks and bonding the sheath to the messenger and the latter to the ground. Marlin hangers are mentioned for the reason that it has been our experience that old metal clips of the zinc strap type, that should a bond break or in the case of unbonded cables, holes are often burned under several clips instead of in one point, under like circumstances with the Marlin hooks; also that these burned places are often entirely covered by the clips and are hard to locate until after moisture may have entered the cable through them. Excessive vibration should also be avoided, such as hanging cables on portions of bridges that are subject to vibration, or on street-car poles, as this will cause the lead in places to become crystalline and porous, making it often necessary to replace entire portions of cable. To protect against lightning and foreign currents being brought into the cables from aerial lines, carbon blocks and fuses should be installed at the terminal pole as well as at the office end. Where there is no danger from foreign currents, such as electric light and street-car currents, the carbon block alone will suffice, while for small terminals on short cables used only for service wire purposes protection at the out end may be omitted with safety. Arresters must be enclosed in weatherproof cans or boxes, as the carbon blocks absorb moisture quite readily. Mica or celluloid will also be found preferable over silk between blocks in outside terminals.

When the insulation drops down in paper-wrapped cables the trouble may be located by the use of the Varley or Murray loop test, or if the necessary "bridge" is not at hand, by careful examination of the cable sheath. When the low point is found, which should be at the earliest possible moment after we have knowledge of it, and is due to the presence of moisture, it is necessary either to open the sheath and force the water out by boiling with hot paraffine above the boiling point of water and not hot enough to char the paper insulation, or possibly where the moisture has penetrated a considerable distance or been present for some time it may be necessary to connect in a new piece of cable, covering the open portion with a new sheath and wiped joints. Cables left open or exposed to the air will collect sufficient moisture to seriously impair the insulation. Cable ends should always be sealed by soldering when cut and to be left for any length of time. In the average plant it will be found to advantage to use lead sleeves and wiped joints in

preference to patent joints, though defective plumbing is often the cause of cable troubles.

The life of cables is governed largely by the method by which they are put up. For instance, if a cable is placed on a messenger of exactly the same length, especially in iron messengers, when the messenger elongates, which it eventually will, the cable becomes drawn tight against poles and slips at turns or corners (if placed on the outside of such turns) and on a slack messenger, the swing is sufficient to break the sheath at the pole. Plow steel is coming more and more into general use because of its ability, when properly guyed, to keep its position and also the advantage of using a smaller messenger.

The maintenance on heavy aerial leads is one of the hardest problems that we have to contend with. Original construction has to do largely with its economical success. If such leads are well guyed, head and side, as may be necessary and all lines are placed in the best possible shape, it is entirely possible to eliminate the ordinary run of open wire trouble.

In the care and maintenance we are on the average very lax.

If we expect to gain control of the toll business in the state it must be through the degree of service that we are able to give.

The matter of induction, noisy lines and the small aggravating things that occur often on the lines must be eliminated. Cases of that sort must be given the same immediate attention that we give the lines that are out of service.

We must speed up a little in the attention that we give the toll lines that we have.

Instruments—While in the average plant it is the instrument itself that receives the last attention, we must not forget that this telephone is our representative before the subscriber, and as its appearance is, and as its part is done in the perfecting of the service, depends the satisfaction with which we are received by the public.

Frequent inspection should be made and a thorough overhauling of the instrument should also be made periodically, more often with telephones of the local battery magneto-call type, because of the larger number of contact parts and also because minor troubles may exist much more readily than with central energy equipment. It is not only essential that the respective mechanical parts of the instrument be in the best of shape, but also that the general appearance be the best possible, for with the average user the appearance goes a long way toward conviction that the rest of the service is satisfactory. A judicious use of furniture oil and nickel polish will do wonders in this line.

Great care should be taken in the installation of the instrument to ensure it from mechanical injury, as well as the house wiring, to ensure continuous operation and low maintenance cost. Soldering of all connections takes but little time in the beginning and saves the maintenance force much labor and consequent expense.

Methods of taking care of trouble reports and the clearing of them are many and varied, but I will here give a plan that is in general use. A "morning test," which covers a test of all the lines on the exchange, furnishes a ready and rapid method of locating any trouble, and is usually checked on stock forms numbered from one to one hundred. These numbers are marked with certain characters to show the trouble with that line, or carried to the back of the slip and there carried out in full. Then transferred to the usual form of trouble ticket, showing number of ticket and line together with the nature of trouble, time reported and any additional information that might be of assistance to the trouble man in locating and clearing the trouble, such as cable pair number, equipment record, etc. If these tickets are methodically kept and the cause of each case and the repairs made are thoroughly reported, a thorough analysis of the trouble may be made, cutting down the number of repeating or recurring cases, eliminating those chronic cases, and showing us where the particular plant may be weak in a certain way, that we may make the necessary corrections.

Don't allow these tickets to be marked "fixed," they are of little use when so marked.

By filing these tickets in order of the line numbers we have a complete record that will show us the exact number of cases of trouble on each line and the reason. There is usually a remedy. In cases of the repeating or chronic nature, a good "follow up" works to fine advantage, and I believe places us in a good light before the public. Mr. Plaister, of Fort Dodge, has devised a good method along this line. By using a return postal card it becomes necessary for the subscriber to make specific complaint, or by failing to reply admit no further cause. A show of interest along this line certainly can not hurt us with our subscribers. It is just as essential that public opinion be well taken care of as anything else.

Let us establish methods in our exchanges that will enable us to anticipate trouble or at least have knowledge of it before the subscriber does, also record and care for these reports with despatch. Try, in fact, the "Schwab" deadly parallel system on ourselves. Get after these things; don't dodge them. Be our own most severe critic of service, when we in our search have found cause for complaint, remove the cause.

If we are to maintain efficiency it is necessary that we use system and discipline, and both must begin with ourselves. Cut out the misspent energy.

Reconstruction of the Properties of the Helena Light and Railway Company.

A contract has been made between J. G. White & Company and the Helena Light and Railway Company, whereby the former company will undertake the reconstruction of the properties of the latter for $140,000.

On September 11, 1905, the public service utilities of Helena, Mont., were bought, reorganized and consolidated under the holding corporation known as the Helena Electric Light and Railway Company. The amount of the transaction was $2,350,000, which covered electric railway, electric light and gas lighting properties. Responsibility for operation was delegated by the corporation to the operating department of J. G. White & Company. During the month of February, 1906, the traffic on the railway was nearly quadruple that of the corresponding month of 1905, and the proceeds from the lighting service were also very materially augmented.

Electric power is supplied the Helena Light and Railway Company by the Missouri River Power Company, and the organizations are united in the ownership of the central substation, from which power is distributed for the public service. The agreement for power supply calls for a rate at maximum of utilization of $25 per horse-power-year.

There are about eighteen miles of track in the railway system, a great deal of which will be reconstructed under the provisions of the contract just signed. Before the reorganization the annual income from the railway property was about $62,000, and from the lighting property, both gas and electric, about $151,000. The combined operating expenses were about $143,000, making the ratio of operating expense to gross receipts sixty-seven per cent. A careful estimate of operating conditions after the contemplated improvement places the gross receipts at $255,000 and the operating expenses at $147,000, thus reducing the ratio to fifty-seven per cent. The estimate for improvement includes $115,000, to be devoted to reconstruction and extension in general, and $25,000 for the relaying of tracks and replacement of overhead construction on main street in Helena.

THE BEST METHOD OF KEEPING LOCAL SUBSCRIBERS' TOLL ACCOUNTS.[1]

BY H. A. DOUGLAS, CEDAR RAPIDS, IOWA.

Managers of the larger exchanges will undoubtedly agree that the keeping, collecting and recording of small local toll accounts is a source of considerable trouble, expense and loss to their exchange.

The majority of the accounts are small and distributed over the entire exchange, and are of such a nature as to make monthly collections almost imperative in order to prevent too great a shrinkage; the loss of a toll bill is usually more than a total loss, as you are in most cases obliged to settle with some foreign line for mileage or terminating fee.

There are naturally many different plans or methods for the handling of this part of the business—almost as many, I might say, as there are exchanges. Some have a subscribers' toll ledger, kept in alphabetical order, containing a record for a year or more, besides the regular monthly toll bills and toll checks; others make a carbon duplicate of each toll ticket, which are kept in an envelope and sent to the subscriber with the toll bill at the end of the month, a most unclean and unsatisfactory arrangement. The card index is used by many, and so on down the line, the majority of them more or less complicated and cumbersome, but by far the greatest objection to nearly all of the methods is the inability of the manager or any one to look over the unpaid accounts for any month or number of months in a few moments without being obliged to go over the record of all of them page by page, or card by card.

In my efforts to find some one scheme that would give a permanent duplicate record with the minimum amount of work and expense and without complications (I believe we have tried them all), I have finally settled upon the present system in use in our exchange in Cedar Rapids, which I will endeavor to explain to you.

The ordinary toll ticket giving all the necessary information is used by the toll operators, from which the office record is made by the toll clerk in the following manner: the toll tickets are carefully examined on the day succeeding the service and while the transaction is still fresh in the minds of all, and any inaccuracies or omission corrected at once. The tickets are then placed in numerical order, beginning with the lowest number. They are then immediately entered upon an individual subscribers' toll bill, under the telephone number, the name naturally being placed on the bill. Each bill is provided with a stub at the top on which is given, first, the month, the telephone number, subscriber's name, amount of toll, messenger service and total, with a space for date paid; below the perforation of the stub is given the telephone number, name and month the service is rendered. The body of the bill gives the date, toll, messenger service and total by whom, to what place, to whom, of each completed call. These bills are made in two parts perforated through the centre, the back half of which is blank for the carbon record. Each bill is supplied with a carbon sheet, which remains in the bill undisturbed until the end of the month, when the bill is completed. On the first day of the month, as soon as the preceding day's business has been entered, these bills are footed and the totals placed upon the stub at the top of the bill. The bill is then torn in two and the carbon removed, the bills sorted into routes as per the route letters and numbers, when they are given to the collectors. It is thereby possible with ease to have the bills out on the second working day of each month. For easily handling the bills and keeping them in good condition and in order, the toll clerk has several files, boxes, in which the bills are placed in their regular numerical order. A smooth strong cardboard is placed between each 100, so that it acts as an index when handling the bills.

From the carbon sheets the total amount of toll charged to each subscriber's telephone number is immediately entered in the subscriber's ledger, under the proper month, on the same line as the subscriber's rental, so that the total amount due for rental and toll can be seen at a glance. The carbon sheets are then filed numerically in a box file labeled with the month as shown. As the bills are paid the carbons are taken out, marked paid, and filed away in a paid file, at the same time the subscriber's account in the ledger is credited paid. The stubs are carefully preserved and are filed away, each day's collections being fastened together after the proper entries in the cash book. We therefore have the original toll ticket, a carbon copy of the toll bill and the collector's stub as an office record.

You will notice that all of these records are kept under the telephone number, which does away entirely with the necessity of an index of any description; as the tolls are paid the carbon duplicates in the unpaid file gradually decrease until the entire month's business has been collected. You can readily see how easy of access and how quickly the unpaid bills can be looked over and any questionable ones given special attention, and at the same time how, with little or no delay, a disputed bill can be verified. You will readily agree that it requires prompt and accurate information and complete records to satisfy a dissatisfied subscriber.

[1] Presented at the recent meeting of the Iowa Telephone Association.

A Simple Accelerometer.

In a paper read recently by Mr. A. P. Trotter before the Junior Institution of Engineers of Great Britain, on "Acceleration and Accelerometers," an ingenious and simple device is described as follows:

Perhaps the most simple accelerometer that can be made consists of a two-foot rule, a piece of thread and a button. Open out eighteen inches straight to form one leg of an isosceles triangle and bend the other six inches to form the base (Fig. 1). Tie a piece of thread round the rule at one and five-eighths inches from the top and a small weight at the other end of the thread. This will form a plumb-line, the base will cut the thread at about 16.1 inches, and the thread will cut the base

A SIMPLE ACCELEROMETER.

at the third inch. Every one-half inch, then, will indicate one foot per second per second, and acceleration and retardation may be easily estimated to one-quarter foot. If the base cuts the thread at eleven inches, every one-half inch will indicate miles per hour per second. Such an accelerometer can be set up on the window ledge of a train. The thread should be set to zero at the third inch and then the rule should be tilted over a little, to put a little friction on the thread. Interesting measurements can be made in this way, but it is tiresome to hold the instrument. Rough measurements may be made by holding an umbrella by a tassel, the tassel being about thirty-two inches from the floor. A match stick will serve for a zero.

Cassier's Magazine for April contains an interesting article on "Electric Advertising Signs" by C. H. B. Chapin.

Some Impending Changes in the American Society of Mechanical Engineers.

The following editorial note and letter have been reprinted from the *American Machinist,* April 5. The matter refers to the request of Professor F. R. Hutton that he be retired from the arduous duties of secretary of the American Society of Mechanical Engineers. The editorial following is a lucid statement of the case, and in addition to conforming with the editorial opinion of our esteemed contemporary, reflects the opinion of a host of members in the society.

"The more intimate personal friends of Prof. F. R. Hutton have for some time been aware that he has contemplated resigning his position as secretary of the American Society of Mechanical Engineers, though it had been thought that he might defer doing so until he should have completed his twenty-fifth year of service in that capacity.

"Recently, however, the work connected with the conduct of the society's business has increased to such an extent that it has seemed to him impracticable to continue to carry the burden along with his work as the head of the department of mechanical engineering of Columbia University, to which he feels he owes his first allegiance.

"Believing that the time has arrived when the society should have a secretary who can devote his whole time and energy to the work of the society, Professor Hutton presented to the council at its meeting in January a letter of resignation. This was not accepted, but action upon it was deferred to give opportunity for conferences with absent members of the council and others, the idea being at the same time advanced that perhaps the services of Professor Hutton might be retained for the conduct of meetings and for the performance of other functions for which he has proven his exceptional fitness; the society employing another man to attend to and supervise the detail work of the secretary's office and to be the business manager; this last-mentioned man to have the title of secretary and Professor Hutton some such title as honorary secretary.

"This plan now seems in a fair way of being carried out. The council at its meeting on March 27 approved the general plan and gave power to a special committee to carry out the necessary arrangements; to select the new man and to rearrange the methods of the office and its personnel, if necessary, in order to institute the new regime.

"In this way the society may for a long time secure the benefit of Professor Hutton's special skill, ability and experience, while at the same time the aim will be to secure an efficient manager for the society's business and routine work, and one who can give much more time to it than it is possible for Professor Hutton to give.

"This action by Professor Hutton has called forth many expressions of the highest appreciation of the work he has done on behalf of the society during the twenty-three years he has been its secretary. It is generally recognized that in the work of building up the society his services have been invaluable, and that for the high position the society occupies to-day its members are very largely indebted to him. It is especially fortunate that it has been possible to so arrange things as to retain his services for those duties for which he has shown ability amounting to genius.

"It is to be understood that Professor Hutton has not retired, and that no change has as yet taken place, but arrangements have been made for making such changes as we have outlined as fast as circumstances will permit without embarrassment to the society."

"LETTER OF PROFESSOR HUTTON.

"NEW YORK, Jan. 29.

"To the Council of the American Society of Mechanical Engineers:

"GENTLEMEN: It may be known to some members of the council that for several years I have had the thought in mind of resigning the secretaryship of the society on the completion of twenty-five years of service. I was first elected in March, 1883. My more recent thought has been that instead of waiting for a merely sentimental period to elapse, which would have meaning to myself alone, I might rather emphasize the more obvious culmination of my service to the society by withdrawing at the time when the society shall cross the threshold of its new home in the Engineering Building. It will then have been given to me to have wrought for the society from the days of small beginnings, when I paid my own office rent and expenses, through the period of rented offices, and of the ownership of the modest home in Thirty-first street and up to the opening of the days of larger opportunity in the splendid surroundings of the new enterprise. It is wise, I am sure, that at the time of this external change the society should also make the internal change incident to securing as its secretary one who will and can devote his entire time to the work and development of the society.

"It is well known to you that I have felt that I must owe and pay my first allegiance to the work of my professorship in Columbia University.

"This being the case, the council should be advised far enough in advance, so that the least embarrassment may be entailed by my withdrawal. I have therefore thought it best to present this formal letter at the first meeting of the year, and to ask by it that proper action may be taken looking to the question for the future which it raises. I ask that I may be relieved of the duties of the secretaryship at the end of the current society year, or at such other time thereafter as the council may see fit to have this resignation take effect.

"It would be my wish and preference that no unnecessary or premature publicity be given to the fact of my decision. I seek to avoid having anything like a 'fuss' made.

"(Signed) F. R. HUTTON,
"Secretary."

The Actress and the Live Telephone Wire.

Miss Blanche Ring is singing a new song called "At the Telephone" in "His Majesty," at the Majestic. Thereby hangs a tale. Owing to the illness of Nelson Roberts, the manager of the company, a telephone has been arranged for him near the electric stand in the first entrance that he may answer calls without leaving his chair. The other night the property 'phone was missing, and the actor who carries it on was at loss till he dragged the stand nearer the entrance, and setting Roberts's instrument on it, instead of the usual "prop," left the comedienne to warble, all unconscious that she was using a live wire. Accordingly when she removed the receiver the girl answered just in time to catch the first words of the chorus—"Hello, give me —— Plaza." Central switched to the number requested, and as Miss Ring sang, "Hello, is that you, Louis?" she was startled by an icy feminine voice which responded, "No, madame, this is not Louis—please ring off!" For a moment the desire to laugh was almost overpowering, but realizing that the audience could hardly appreciate the fact that she was taking part in a duet rather than a solo, she continued bravely, while the answering voice grew louder and louder as the verses flew over the wire. —*N. Y. Mail.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Electric central station advertising means simply educating the public to the adaptability of electricity to the every-day needs of the office, the factory and the home. The people really want to know about the possibilities of electricity, but the central station manager must devise ways and means of stimulating this curiosity and of making it current consuming.

When it comes to a question of business, of buying and selling, electricity is like every other commodity on the market. So much hard work was necessary to bring it to the practical service of every-day life that the business side has been neglected. To-day, however, the case is different. Men with a knowledge of salesmanship are putting electric current on the market as a salable product. These men are succeeding deservedly, and yet there are many who are not alive to the ever-increasing demand of the public.

What manufacturer, having five hundred customers on his books and the capacity to supply one thousand more, would instruct his factory superintendent to attend not only to the regular duties in the shop, but also to act as shipping clerk, collector and salesman, and, relying altogether on this one man, should entirely neglect to advertise? The idea is absurd; yet there are many electric lighting companies doing exactly this thing, and whose managers are acting in all these capacities at once.

The large central stations have evolved a method which is bringing in results, and yet which is practicable only in large cities where it is impossible to reach prospective customers personally. This plan consists of a department which works in conjunction with the salesmen. A list of every firm in each branch of business is filed on cards under separate headings. A man may be a possible user of electric current for lighting or power in its various phases. He is canvassed for every phase by letter, folder, picture postal card, illustrating some other establishment using the current in a manner suggestive to his needs, and finally a bright, readable magazine.

Of course, all of these suggestions are not sent at once, but at intervals, keeping his attention alive. Each clean-cut typewritten letter is accompanied by a return postal card, with the necessary form printed, so that the prospective customer has only to sign his name and mention a convenient hour when a salesman may see him to talk over the matter. Then the contract is almost the same as closed; but should the prospective new customer need further attention, the salesman reports to that effect, giving the follow-up department opportunity to use certain telling documents, which are forwarded to him from time to time. It is then simply a question of patience and persistently keeping after him. He will be convinced, sooner or later, and will finally sign a contract.

Private plant operators are subject to almost the same treatment. They are on a list by themselves, and every time the newspapers publish an account of a boiler explosion, each owner may receive a reproduction of this article, with fitting suggestions of how he can avoid the same danger. He may also be often reminded of how he can dispense with the annoyance and dirt of his plant.

In connection with this, the periodicals published by many central stations, usually designated as the "Bulletins," of the several stations, are far-reaching in their effects. Every month these bulletins publish pictures and details of some private plant shutdown, and mention the central station service adopted, giving convincing reasons for the change. This can not help proving of interest to the private plant owner, and before he is conscious of it himself, he is becoming dissatisfied. At this stage the private plant man of the central station wins.

Prospective customers of electric signs are interested in a different manner. Attractive pictures are sent to them, and an occasional letter; but the first and most important step for the central station to take is to erect an attractive electric sign —perhaps more than one—to show that it believes in that method of advertising. This sign should be the best obtainable, and always operated at the highest efficiency.

Although it seems unnecessary to say anything about it—as it would naturally be the first thing an electric light company would do—it is astonishing to note how few companies realize the possibilities of advertising by means of their own well-lighted show-windows and offices. Every one is watching for something attractive, and what can attract more attention than a well-lighted window and showroom. This method is more adaptable to central stations in the smaller cities.

In a city having a population of 50,000 a bulletin like those just mentioned would be impracticable; the people can be reached better and more directly by display and newspaper publicity.

Many of the larger electric light companies maintain showrooms where various pieces of machinery are exhibited, driven by electric power; demonstrations are given in electric cooking, and different methods are illustrated of illuminating show-windows, and many other interesting and novel ways of employing electric current. A large display is not needed, nor is such a display possible for every electric light station; yet each can have a display in a modified form and one which will reach its possible customers.

Central station managers are always particularly anxious to increase their power load, and the follow-up letter may be used to this end very advantageously. The adaptability of the motor to practically any power conditions, the low cost of making extensions—merely the expense of additional motor perhaps—the possibility of overtime work in one department without the necessity of keeping the whole plant running, the absence of shafting and belting and the consequent saving in wasted power, the safety and convenience, no dirt or dust and no oil dropping from overhead bearings, are a few of the many advantages which should be placed before the prospective customer.

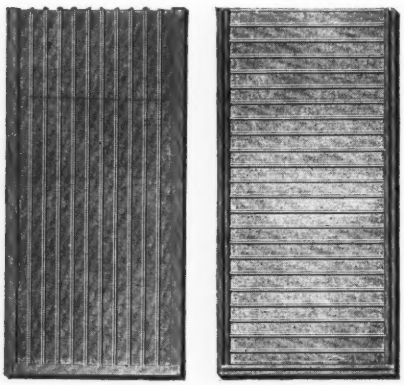
A form of advertising as a means of keeping old customers awake as to every new use of electric current is an attractive folder or small blotter enclosed with the monthly bill. This kind of publicity is inexpensive, as there is no extra postage. The message reaches the people whom you wish to interest, and often leads to increased use of the service. If these folders and blotters are kept in the office on view, every visitor carries off one or two. In this way, again, is the question of distribution of the company's literature settled.—C. N. B. CHAPIN, *in Cassier's Magazine.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Hatch Accumulator.

The Hatch Accumulator Company, 60 State street, Boston, Mass., has incorporated in the improved Hatch accumulator a number of features which are distinctive in character, and which, it is claimed, render these batteries remarkably reliable and endow them with a very high efficiency. While there is no new chemical or electrical principle involved, the facility with which the proper chemical and electrical reactions are allowed to proceed is one of the chief features of the improved Hatch accumulator. The principal characteristic of the mechanical construction lies in its compactness, light weight and rigidity. The elements consist of the conducting electrodes, enveloped by a porous pottery grid structure which carries the active material. Fig. 1 and Fig. 2



FIGS. 1 AND 2.—POROUS POTTERY ENVELOPES.

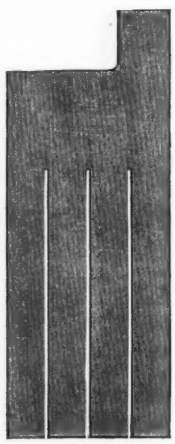


FIG. 3.—ROLLED LEAD CONDUCTOR.

show the two sides of the porous envelope. These porous plates are composed of a combination of kaolin and silica, so proportioned as to give great porosity and rigidity, and at the same time have such strength as will make them practicable for the service required. The negative side of the plate, with its longitudinal corrugations, is shown in Fig. 1. The positive side, which has transverse corrugations, is shown in Fig. 2. The plate is seven and one-half inches long and three and three-quarter inches wide. The active material is spread on the positive face of the porous envelope, and the lead conductor or electrode, shown in Fig. 3, laid upon this and firmly held by another plate similarly treated.

The electrodes are cut from rolled sheet lead, and the size is made to fit snugly within the raised edges which run about the sides and bottom of the porous plates.

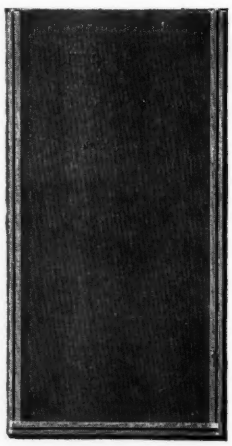


FIG. 4.—POROUS ENVELOPE COVERED WITH ACTIVE MATERIAL.

The active material is spread upon the positive face until it is filled even with the outside raised edges, as may be seen from Fig. 4. While the paste is still moist the prepared lead electrodes are interleaved between the raised edges of the filled plates. This process is shown in Fig. 5 and Fig. 6. The whole is then dried under pressure until the mass of lead paste is firmly set with the electrode embedded therein. When this process is completed the elements are ready to be placed in stock indefinitely for use in assembling when required.

The lead paste used on the negative electrodes is a special composition, so compounded that it causes the active material to set in a hard mass. On the negative element the paste can not be confined in the same manner as the positive material, but to secure the best electrical results must be in direct contact with the electrolyte, so that the action of the gases may go on very freely and the gas may be allowed to escape not only into the electrolyte, but out of the cell. A negative electrode similar to that embedded in the positive plates is placed in a mould, and both sides of the plate covered with the negative lead paste. After becoming set it is suspended between the prepared positive plates, so that the ribs of the negative side of the porous plate bear against the mass, thus holding it in place, while at the same time the grooves between the ribs allow a free circulation of the electrolyte in contact with the face of the negative active material.

FIG. 5.—ELECTRODE AND POROUS POTTERY ENVELOPE.

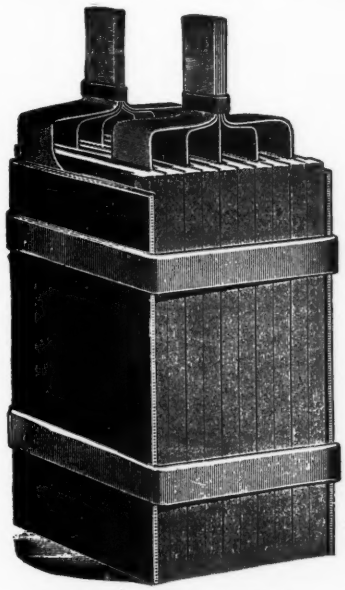
A feature of these batteries is their arrangement into various sized units. When a sufficient number of the prepared pairs of positive porous plates and negative electrodes has been assembled, they are flanked

FIG. 6.—METHOD OF INTERLEAVING POSITIVE ELECTRODES.

with a prepared wooden back and the whole is banded with pure rubber bands. The company has decided on a uniform size of unit, and larger capacities are ar-

ranged by simply multiplying the number of units to suit the requirements.

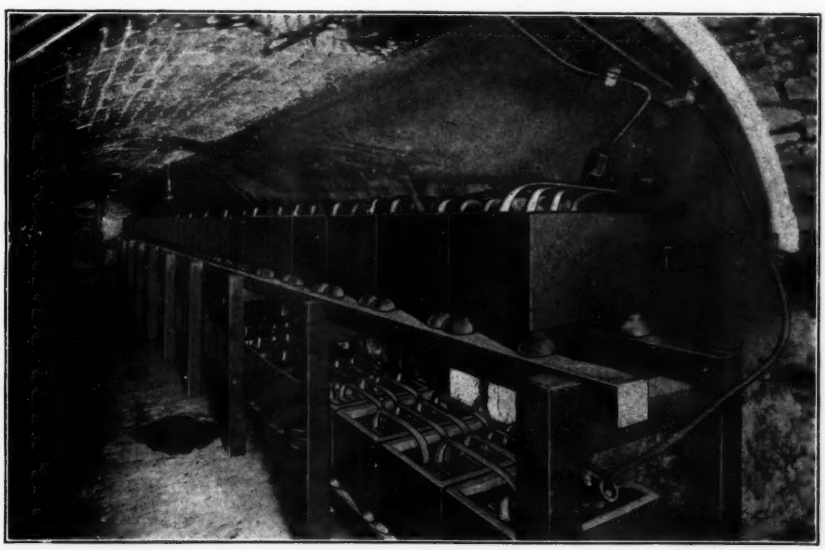
As the unit is assembled it is placed in a glass jar entirely surrounded by the electrolyte. The porosity of the envelope is such that an unimpeded circulation of



Assembled Accumulator.

the electrolyte is possible, and the arrangement of contact is such that a maximum surface is exposed to the action of the electrolyte. The porous envelope also splits up the minute gas bubbles which form at the negative electrodes and eliminates spattering. The rubber bands give just enough elasticity to the unit to compensate for a very slight swelling which takes place during the electrochemical reaction going on under charge and discharge in the battery. The longitudinal corrugations pressing against the negative electrodes set up a capillary action which creates a continuous circulation of the electrolyte, maintaining a uniform density throughout the cell. The transverse corrugations holding the active material on the positive faces of the porous envelope, pressing against the lead electrodes, eliminate the possibility of the active material loosening and dropping to the bottom of the cell.

This battery has recently been subjected to very severe endurance tests made by an expert of unquestioned authority, and it is stated that these tests have revealed characteristics which substantiate the claims of the maker with regard to life and efficiency. Under the severest tests, said to be sufficient to destroy any ordinary battery, this battery seems to have remained undisturbed. The watt efficiency, upon test, has been found to be as high as that of any other battery when new, and the destructive tests prove that this battery maintains its high ratio of watt efficiency practically during the life of the cell. These destructive tests also indicate that the battery has very high capacity and that there is no derangement of the cell even under extraordinary conditions of charge and discharge.



A 100-Light Installation of Hatch Accumulators.

Patent Office Statistics.

According to the Patent Office *Gazette*, the week ending April 3 was one of the greatest in the history of that bureau. There were issued 1,026 patents, reissues, trade-marks, labels, prints and designs. The number of trade-marks alone for the week has reached the record sum of 377.

Patent officials state that the average issue of patents, trade-marks, etc., amounts to 700 or 800 a week, and they declare that the size of the issue is an invariable indication of the prosperity of the country.

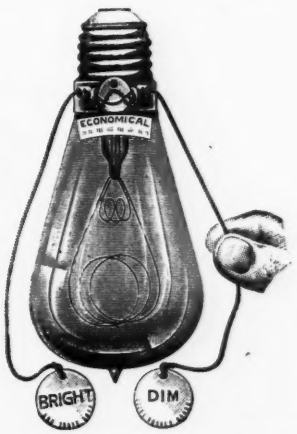
Turndown Incandescent Lamps.

The Economical Electric Lamp Company, New York city, manufacturer of the "Economical" turndown lamp, is making a feature of supplying central stations with illustrated pamphlets to be enclosed with monthly lighting bills, or mailed separately, with the name and address of the lighting company printed thereon. These

Turn-Bulb Type, Turndown Light.

pamphlets are designed to show by illustration the advantages, convenience and economy in the use of a turndown lamp in the household, for such places as bathrooms, halls, nurseries and sick-rooms, where a dim light is always convenient, if not necessary.

The Economical Electric Lamp Company also pays the salaries of several women demonstrators, whom the lighting company may supply for canvassing its customers, showing the simplicity and economy of the turndown lamp and securing orders for as many as may be needed in a house on blanks for the purpose, which are turned in at the close of the day for filling by the station.



Pull-String Type, Turndown Light.

The company also furnishes to the central station, for use in its office or showrooms, one of its mechanical demonstrators or silent salesmen. This device shows automatically the simplicity of operation of the turndown lamp.

Electric Fans for 1906.

DURING the last two or three years electric fans have become more or less standardized, and while the various lines for 1906 show many advances, designers have kept pretty well to the beaten path, and the characteristic features for which more or less merit has been claimed for some time past will be found to dominate the design and construction in almost every fan motor supplied for the present season. In the following pages will be given a brief summary of the principal features of several styles of fan motor apparatus. This summary will include descriptions of desk and portable, bracket and ceiling fans, for both direct and alternating current, as well as ventilating apparatus for work of a larger scope.

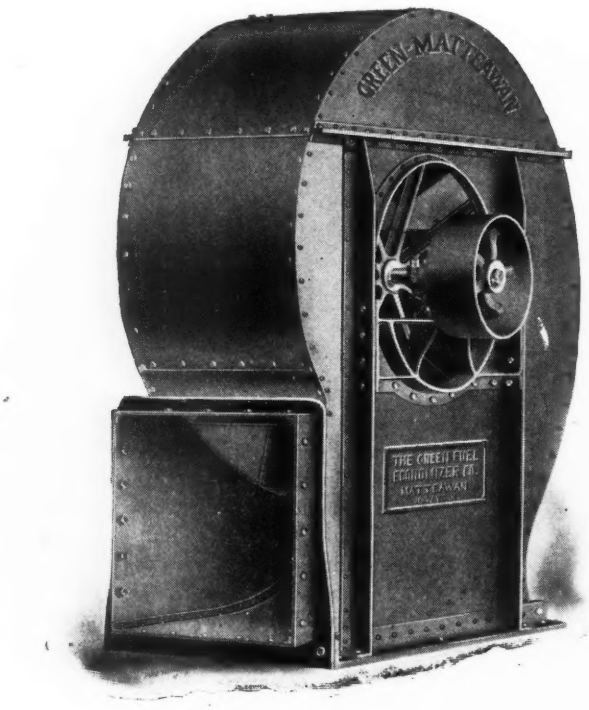


FIG. 1.—GREEN VENTILATING FAN.

THE GREEN FUEL ECONOMIZER COMPANY, MATTEAWAN, N. Y.

In attacking the problem of summer ventilation, the Green Fuel Economizer Company works away from the idea of making use of a number of small fan units, which, it claims, stir up the air in certain directions without effecting a uniform change of temperature. The apparatus manufactured by this company is arranged for moving large volumes of air, effecting complete changes in the circulating system and facilitating a reduction of body temperature by making possible a considerably lower atmospheric temperature, to which the heat of the body may pass. For handling air in large quantities, and against any appreciable pressure, as through flues or registers, the centrifugal blower or exhauster, it is claimed, is the most economical appliance. The Green Fuel Economizer Company has gone into the ventilating business quite extensively and has introduced a number of improvements in the design of this apparatus. Fig. 1 shows a Green ventilating fan. An important requirement in the case of fans supplying air to living rooms is that they should be noiseless. This can be secured by rigid construction and perfect balance.

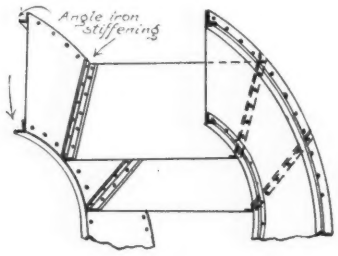


FIG. 2.—ANGLE IRON STIFFENING, GREEN VENTILATING SYSTEM.

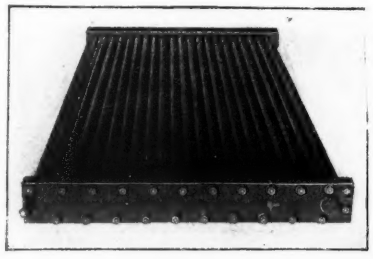


FIG. 3.—HEATING COILS, GREEN VENTILATING SYSTEM.

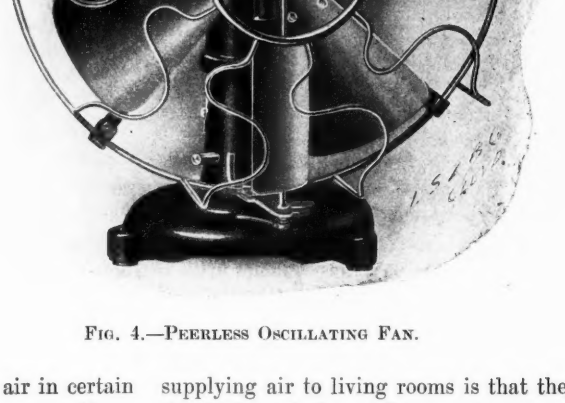


FIG. 4.—PEERLESS OSCILLATING FAN.

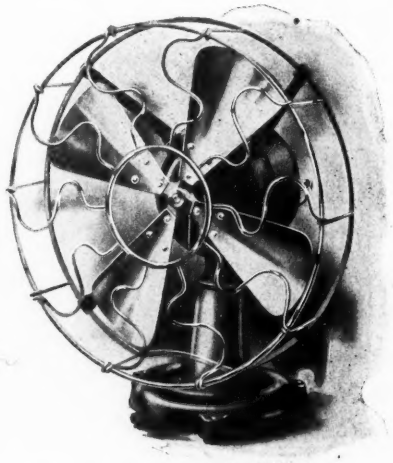


FIG. 5.—PEERLESS DIRECT-CURRENT DESK FAN.

The fan wheels built by the Green Fuel Economizer Company are rigidly reenforced by stiffening rings of angle iron riveted to the inner and outer edges of

the side plates and also by short pieces of angle iron, which are used to attach the floats to the side plates. Fig. 2 shows the angle iron stiffening construction.

The wheel of a ventilating fan should be very carefully balanced, the matter of effecting the balance of a rotating body requiring very great care in the mechanical construction and nicety of assembly. All of the fans built by the Green Fuel Economizer Company are subjected to a running balance test. In many cases it is possible to make a room more comfortable not only by renewing the air, but by cooling it. This may be done by a regular heating outfit with the heating coils so arranged that there is a proper circulation of water through them. On a sultry day, when the percentage of moisture in the air is high, a comparatively small drop in the temperature will bring the air to its "dew" point, causing the precipitation of some of the water contained. If this air is then sent to living rooms where its temperature is again increased, it is drier than the surrounding air of the atmosphere and better able to take up moisture than before. The Green patent heating coil shown in Fig. 3 is especially adapted to this purpose. This consists of two headers connected to a large number of straight pipes. Water may be forced into one header and escape through the other, the circulation being positive, eliminating dead spaces and ensuring the coil from becoming air-bound. Further, the coil is easily drained. The tubes are arranged horizontally and can easily be removed or mended.

THE PEERLESS ELECTRIC COMPANY, WARREN, OHIO.

Every distinctive feature of the Peerless fan motor has been retained, and attention has been concentrated upon increasing the efficiency of the motors by embodying every electrical and mechanical improvement that years of experience and progressiveness can suggest. Particular attention has been given to the finish in japanning, polishing and lacquering, and in strength and shape the Peerless guards and blades have been carefully looked after. Fig. 4 shows the type "O. D." oscillating fan. The field, or rotating part, travels on a new type of tempered ball bearing. Swinging slowly from side to side, the fan distributes a breeze to all parts of the room. A blade or vane located just inside the guard operates the mechanism impelled by the air from the fan blades. This actuating device is simple and positive, and has been altogether redesigned since last season. Collector rings and brushes placed above the two-speed switch in the base of the fan makes it possible to discard the auxiliary flexible lead connections.

Fig. 5 shows the type "D" direct-current desk fan. This is a new fan for this season having a swiveled frame, but without a trunnion. No attempt at ornamentation has been made, the finish being black japan with brass finished guard and blades. This fan has three speeds, and is strong and well built.

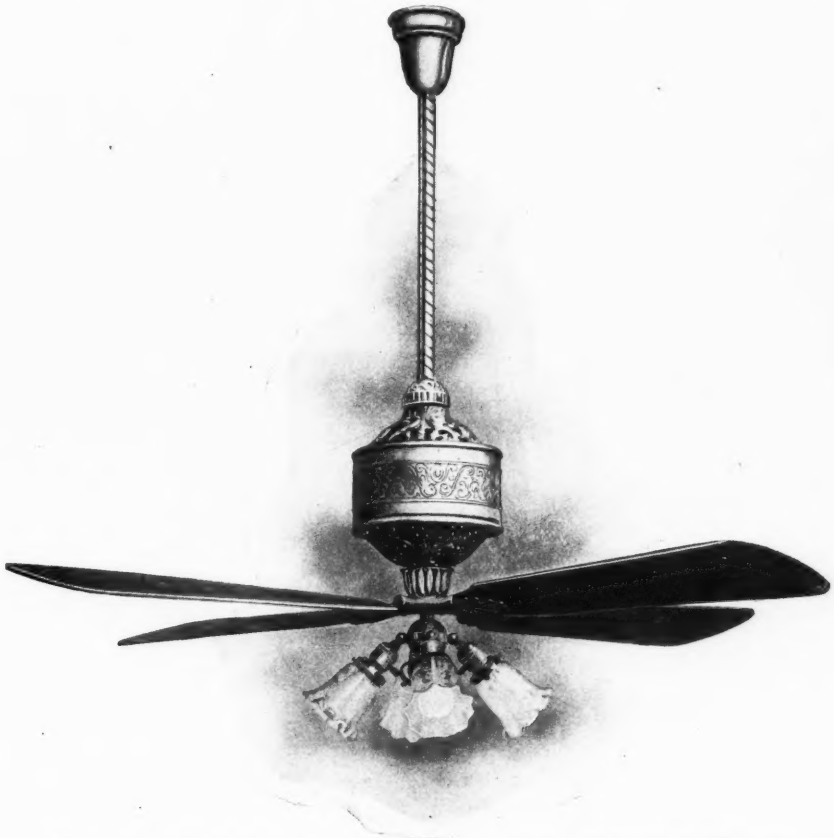


FIG. 6.—PEERLESS DIRECT-CURRENT CEILING FAN, WITH FOUR-LIGHT ELECTROLIER ATTACHMENT.

FIG. 7.—PEERLESS COLUMN FAN.

Fig. 6 shows the type "H" direct-current ceiling fan with four-light electrolier attachment. The standard length of fan from ceiling to lowest extremity is four and one-half feet.

Fig. 7 shows the Peerless column fan. This is substantially constructed and is driven by a one-eighth-horse-power motor. It is provided with the usual self-oiling bearings and will run the entire season without attention. The heavy base is secured to the floor with screws. The standard finishes are in polished brass, oxidized copper or nickel.

THE WESTERN ELECTRIC COMPANY, CHICAGO, ILL.

Thousands of the Western Electric Company's fans are now in use throughout the country and need no introduction to the trade. A new type of fan, termed the "Universal," has been added to the regular list of fan motors. The motor body is of the enclosed type, and the frame

has swiveled and trunnion attachments. The great advantage of the "Universal" fan is that it can be changed from desk to bracket model without the help of a separate part. Fig. 8 shows the "Universal" fan as a desk motor, and Fig. 9 the

FIG. 8.—WESTERN ELECTRIC ADJUSTABLE DESK FAN.

"Universal" fan as a bracket motor. This fan is manufactured in one type and one size. Fifteen-inch blades have been adopted, and the body of the motor is highly finished with black enamel and the blades, guards and trimmings are of lacquered brass.

The motor is spherical, entirely enclosed. The armature is of the slotted type. The field coils are elliptical in shape, machine wound and specially insulated. Cartridge type brush-holders are used, fitted with carbon brushes. An arrangement of a switch in the base permits of the follow-

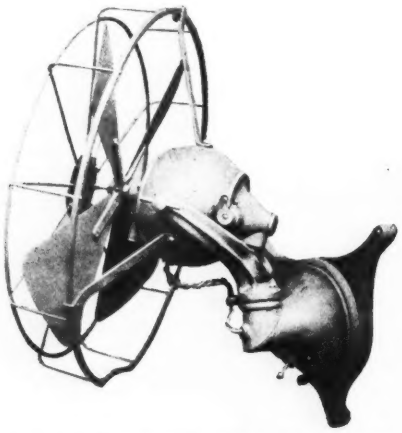


FIG. 9.—WESTERN ELECTRIC ADJUSTABLE BRACKET FAN.

ing speeds: 1,480, 1,100 and 750 revolutions per minute.

THE GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

The General Electric Company's fan motors for 1906 retain all of the distinctive features of previous years. The general appearance of the 1906 fan is very similar to its predecessors, and it has retained the good qualities of careful design and construction dictated by long experience. Both direct and alternating-current fans have a special blade design, a positive trunnion adjustment and perfect lubrication. In the design of the blades the end attained is that of distributing the air over a wide angle rather than delivering a straight column of air covering a limited area. The positive trunnion adjustment permits a quick changing of the breeze for either horizontal or vertical circulation. Wick oilers are provided and require no attention beyond the annual renewal of oil.

The special features of design for the General Electric alternating-current fans include the limit of compactness and simplicity. For frequencies of sixty, 125 and 140 cycles this type of fan consists

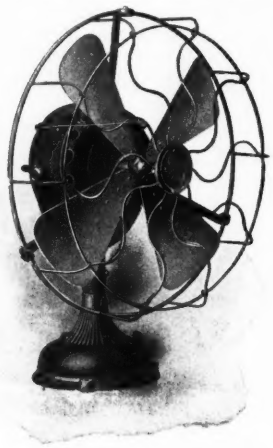


FIG. 10.—GENERAL ELECTRIC ALTERNATING CURRENT DESK FAN.

of a single moving element without contacts, revolving in a ventilated cast-iron field frame of compact design. Speed changes are obtained by a six-point reactive coil and switch. The General Electric Company's direct-current fans have cast-iron frame of elliptical form, with ventilated removable end shields. Rectangular brushes are used, giving a large area of contact on the commutator. An ingenious brush-holder ensures constant brush pressure. Speed regulation is provided in the direct-current desk and wall bracket types by a self-contained, four-point regulating switch giving three speeds. Fig. 10 shows the General Electric alternating-current desk fan and Fig. 11 the direct-current bracket fan.

The General Electric ceiling fans are ordinarily equipped with wooden blades, but can also be furnished with aluminum blades for use in damp locations. The company furnishes the direct-current ceiling fans for either one or three speeds. In the three-speed fan the regulating device is self-contained and operated by a button at the bottom of the fan. Fig. 12 shows a three-speed fan with fifty-eight-inch sweep.

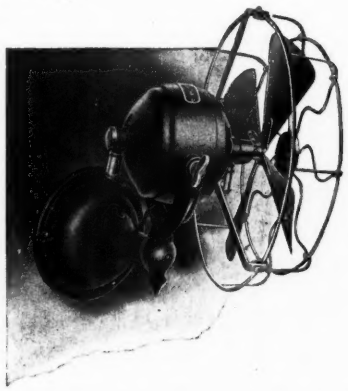


FIG. 11.—GENERAL ELECTRIC DIRECT-CURRENT BRACKET FAN.

For special ventilating purposes, such as kitchens, hotels and restaurants, the company supplies an exhaust type of fan for use on both alternating and direct-current circuits. These comprise the body of the swivel and trunnion type of the respective direct-current and alternating-current fans mounted in a special bracket, as shown in Fig. 13, for suspension in windows or ventilating shafts.

Another type for both alternating-cur-

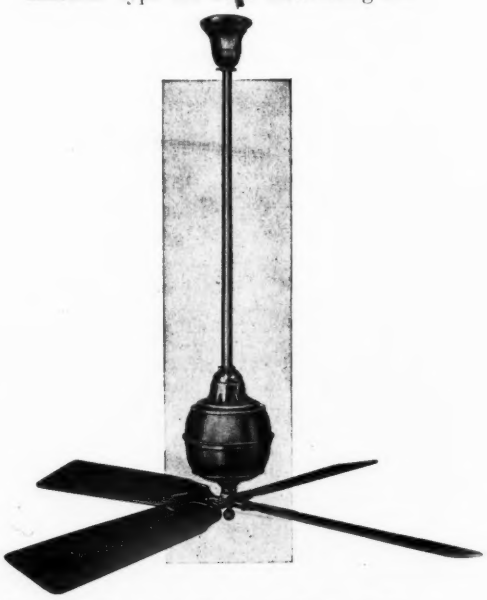


FIG. 12.—GENERAL ELECTRIC CEILING FAN, 58-INCH SWEEP.

rent and direct-current circuits is a compact telephone booth fan motor, shown in Fig. 14. These various types of motor are furnished in standard commercial sizes and for any commercial voltage or frequency. They can also be ordered with

special windings for operation on odd voltages or frequencies. In general, the standard finish is black with brass trimmings, but this practice, too, may be varied to suit the taste of the customer.

THE DIEHL MANUFACTURING COMPANY, ELIZABETHPORT, N. J.

The Diehl Manufacturing Company is showing its usual extensive line of desk and bracket, ceiling and column fans. Fig. 15 shows the No. 44 fan, which has been designed to meet a demand for a cheaper fan than the company's standard fans. It

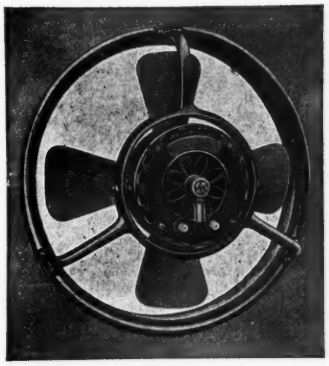


FIG. 13.—GENERAL ELECTRIC ALTERNATING-CURRENT EXHAUST FAN.

is of the iron-clad type, presenting a neat, compact and symmetrical appearance. The armature core is toothed, and the winding is put on by machine. The commutator sections are built up of hard-drawn copper insulated with mica only. The oiling system is adequate, and there is no possibility of throwing or dropping of the oil. The oil reservoirs need filling but once each season. The fan is furnished complete with four blades carried by malleable iron blade-holders finished in polished nickel. On this ceiling fan, and also on the "Universal" desk fan, square brushes are used, giving a large increase of brush contact and also a long life of the brushes.

The company is calling particular attention to the regulators, giving a variation of three speeds, which can be installed on all 110 and 220-volt ceiling fans. These regulators are made of mica plate wound with high-grade resistance wire. The plates carrying the wire are separate units, and are combined in proper numbers to give the required resistance for the style of fan and voltage.

Fig. 16 shows the "Universal" fan motor set at an angle; Fig. 17 this fan motor used as a bracket fan. This represents one of the most advanced ideas in the development of fan motors, combining in one unit a desk, trunnion or bracket fan. These fans may be adjusted to propel the air in any direction. To change from desk to bracket, or vice versa, a screw is loosened, separating the two halves of the ball on the spindle. The position of these pieces is located by a pin on one-half engaging a hole in the other. By loosening the screw sufficiently to disengage the pin from the hole the two halves may be rotated on themselves for a quarter turn.

AMERICAN BLOWER COMPANY, DETROIT, MICH.

The blades and central discs of the American Blower Company's disc ventilating fans are the two features upon which the company bases its claim for large volume of air handled and delivered against pressure. There are twelve blades in these fans and each blade is made of steel, overlapping the one next to it. Each blade is bolted to each of two large centre discs, one of which is on each side. The increased number of blades assures a proportionally high delivery of air, and the extra support of the discs gives additional strength. An even greater function of the discs is the prevention of a back flow of air through the centre when working against pressure.

Fig. 18 shows a forty-two-inch ventilat-

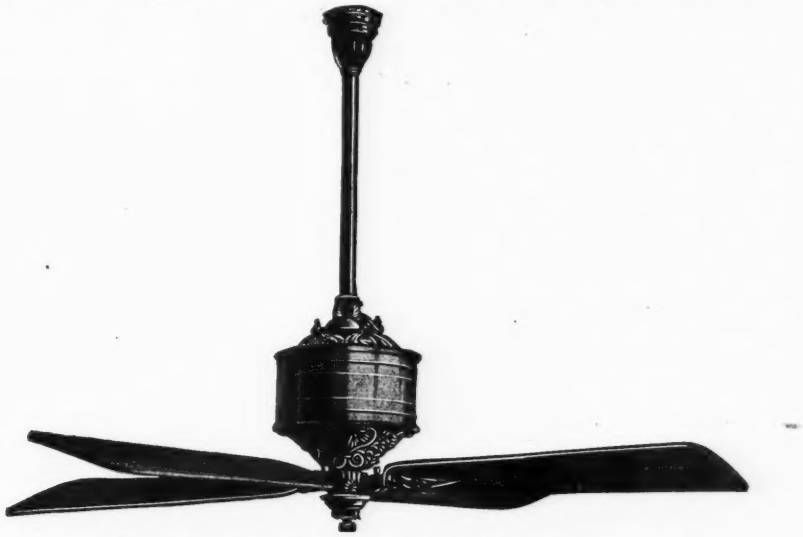


FIG. 15.—DIEHL NO. 44 CEILING FAN.

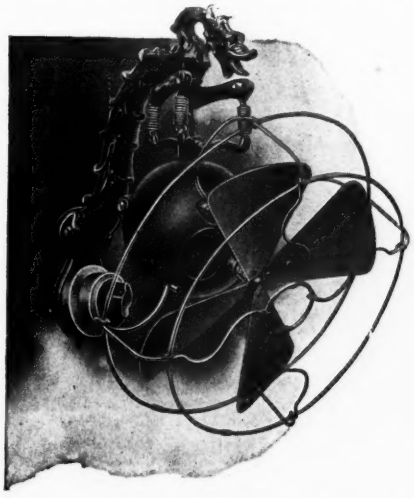


FIG. 14.—GENERAL ELECTRIC TELEPHONE BOOTH FAN.

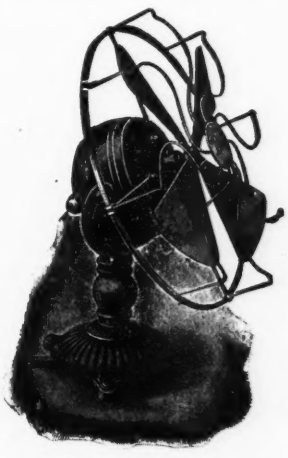


FIG. 16.—DIEHL "UNIVERSAL" AS A DESK FAN.

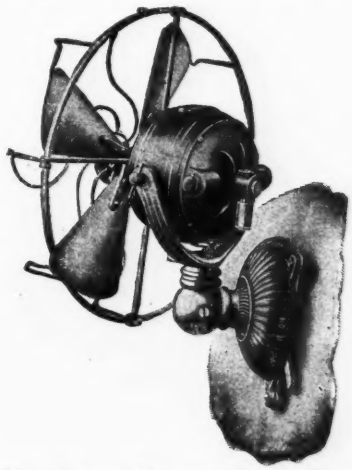


FIG. 17.—DIEHL "UNIVERSAL" AS A BRACKET FAN.

ing fan with the standard base and pulley. Fig. 19 shows a disc ventilating fan with a flanged motor set in a saddle direct-connected to the disc apparatus. The company is now making a fan apparatus espe-

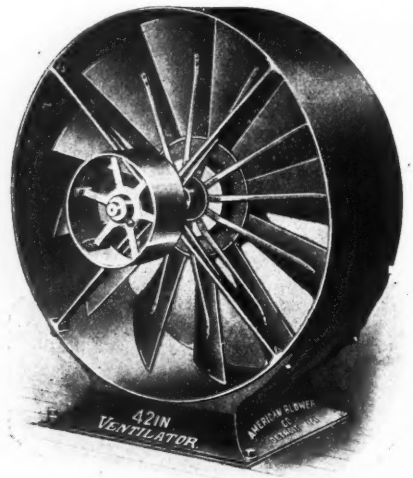


FIG. 18.—"A. B. C." DISC VENTILATING FAN, WITH STANDARD BASE AND PULLEY.

cially adapted for building into a brick wall. The motor is placed in a basket or saddle, which forms part of the ventilating disc framework. This outfit forms a very neat and compact system.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, ST. LOUIS, MO.

The Wagner Electric Manufacturing Company is meeting a popular demand with a single-phase, variable-speed ventilating fan with an autotransformer control. Fig. 20 shows the adaptation of the

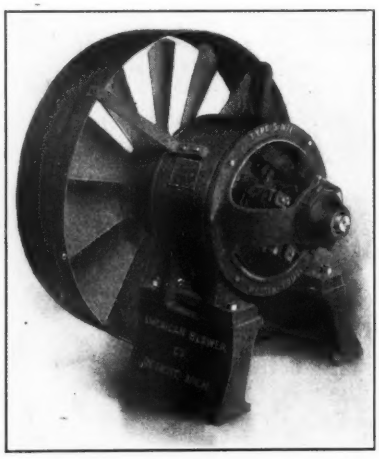


FIG. 19.—"A. B. C." DISC VENTILATING FAN, WITH DIRECT-CONNECTED MOTOR.

variable-speed fan motor; Fig. 21 the autotransformer used with this fan. These fan motors run at 1,165 revolutions per minute. The autotransformer device consists of a single-coil transformer having a number of taps brought out to the small switching and terminal head, all being mounted in a neat box. This method of motor-speed control effects a large saving in cost of current. In laying out a ventilating system it is often desirable to take advantage of the direction of the external air. For instance, where ventilating fans are used in restaurants, and where these may be located in downtown districts, the room very often takes the shape of a long rectangle opening on the street in front and upon an alley in the back. An effective means of perfectly ventilating such a room would consist of the installation of two single-phase, direct-connected ventilating fans, each fitted with an autotransformer control and a throw-over switch for reversal of direction. Advantage could then be taken of the direction of the wind, so that there would be

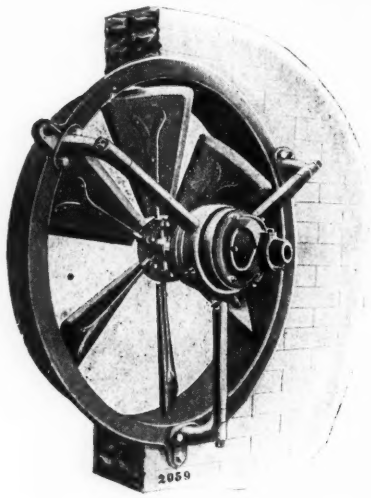


FIG. 20.—WAGNER SINGLE-PHASE, ALTERNATING-CURRENT VENTILATING FAN.

continually a free circulation of air in the room.

THE STAR ELECTRIC COMPANY, NILES, OHIO.

The Star Electric Company is a newcomer in the fan motor field. This company is now showing an attractive line of direct-current fans embracing the type "A" or swivel fan, the type "B" or swivel and trunnion fan, and the type "C" or oscillating fan. The Star fan is of the standard iron-clad type with extra strong mechanical construction. The body is heavily enameled in black and polished and striped with gold. All brass parts are highly polished and lacquered. The swivel and trunnion fan has an extra connection with which a wall attachment may be made. The oscillating fan is of the well-known single-blade construction, which has proved most satisfactory in the past.

Fig. 22 shows the type "A" swivel fan and Fig. 23 the type "B" swivel and trunnion fan.

The armature is built up of sheet steel laminations, the commutator segments being cut from hard-drawn copper insulated

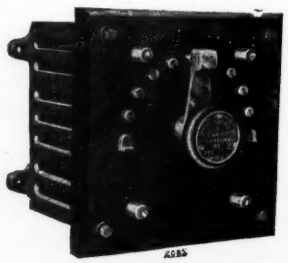


FIG. 21.—WAGNER AUTOTRANSFORMER CONTROLLER.

with the best grade of Indian mica. The lead wires are fastened securely into slots milled in the ends of the commutator segments and are bound to an asbestos ring. Self-aligning bearings made from phosphor bronze are used. The bearings are lubricated with wick oil cups of sufficient capacity to last the entire season, and the fans are equipped with an oil-catching device.

The brushes consist of a special grade of carbon pencil of ample cross-section and extra length. Compression springs effect an even pressure and admit of the brushes being used up to almost their entire length. The mechanical and electrical design of these fan motors has been very carefully worked out, and the insulation problem has been given extra consideration.

The speed-regulating device is made up of German silver wire wound on a porcelain spool. This device gives three distinct speeds and a cutout.

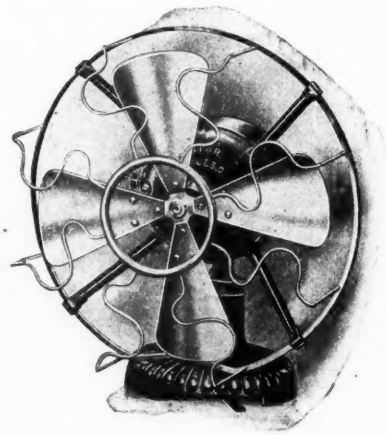


FIG. 22.—STAR SWIVEL FAN.

THE JANDUS ELECTRIC COMPANY, CLEVELAND, OHIO.

The Jandus Electric Company is again calling attention to its line of bracket fans, desk fans and column and ceiling "Gyro-fans." Fig. 24 shows the Jandus com-

bination desk and bracket fan. A simple wrist movement combined with a lateral movement adjusts the blast of air to any required direction, either as a desk or wall fixture. The standard finish of the Jandus fan is black enamel, and the blades and guards are highly polished and lac-

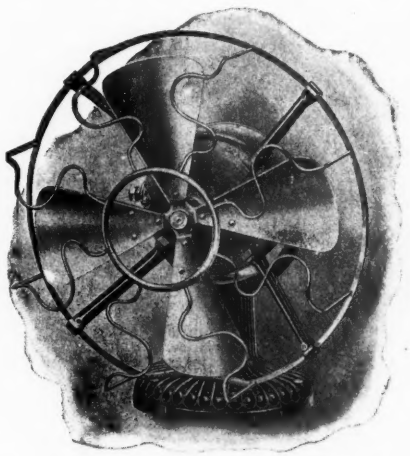


FIG. 23.—STAR SWIVEL AND TRUNNION FAN.

quered. The mechanism has been described and includes all the well-known practices which go to make up a standard product.

Fig. 25 shows the ceiling "Gyrofan." The "Gyrofan" consists of two fan motors

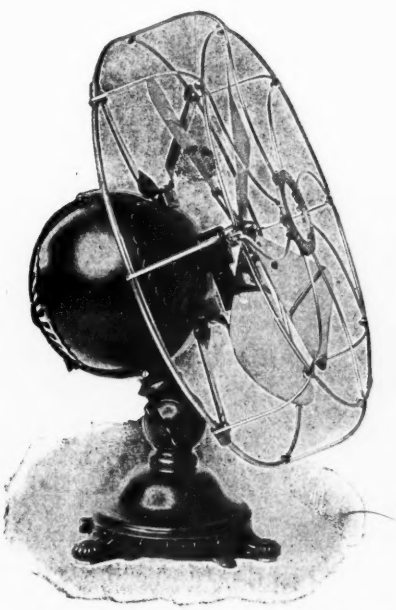


FIG. 24.—JANDUS COMBINATION DESK AND BRACKET FAN.

pivotally mounted on a frame which is arranged to revolve about the vertical axis on a ball bearing. The force utilized for the revolution of the motors results from an angular adjustment of the motor shafts with respect to the plans of the vertical axis of the fixture. The two fans can be set to blow horizontally or at any downward angle, and one fan can be set at a different angle from the other. With the ceiling "Gyrofan" an electrolier attachment is arranged with four contacts, so that the fans may be operated alone, the lights alone, or the fans and lights simultaneously.

THE HUNTER FAN AND MOTOR COMPANY, FULTON, N. Y.

This company has discontinued the use of the names "Hunter" and "Fulton" for

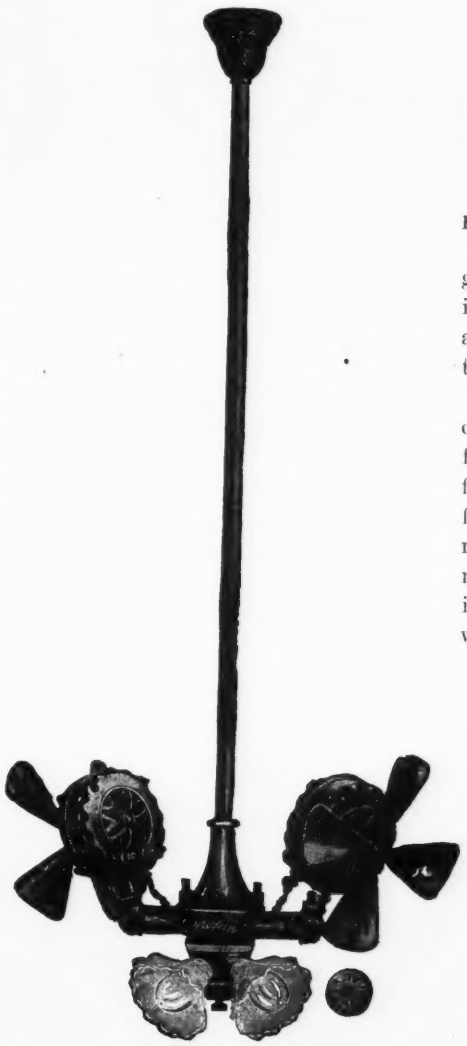


FIG. 25.—CEILING GYROFAN.

several of its designs, and is now using the designation "Tuerk" for its entire line of alternating-current fans. Special attention this year is being called to the type "B" fan shown in Fig. 26. The fan motor is of the induction type with a ventilated case. This fan is built with two or four blades, sixty inches sweep, eight inches wide. The current consumed is 110 watts at full speed, 175 revolutions per minute; eighty watts at second speed of 150 revolutions per minute. When the current is thrown off the revolving case is raised from wheels, ensuring perfect condition. Turning on the switch starts the motor before the case touches the wheels. The second pull on the chain secures the second speed. The indicator inside of the case tells at a

FIG. 26.—"TUERK" TYPE "B" CEILING FAN.

glance the speed and also when the current is off. This ceiling fan may be made into an electrolier fan by the insertion of electrolier tubes and attaching sockets.

Fig. 27 shows the type "C" induction ceiling fan. This is equipped with two or four blades, the two-blade type having fifty-six-inch sweep and the four-blade fifty-two-inch sweep. The speed is 225 revolutions per minute. Fig. 28 shows the new column fan. The fan motor is of the induction type. The motor is equipped with two or four blades, sixty-inch sweep,

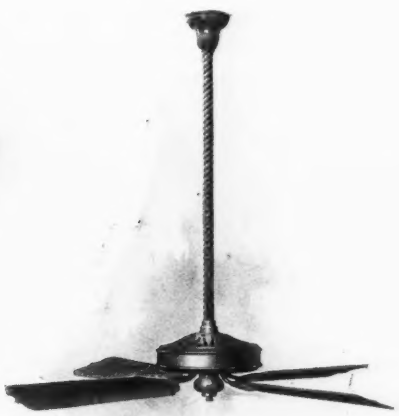


FIG. 27.—"TUERK" TYPE "C" CEILING FAN.

eight inches wide. The two-speed switch is operated from the bottom of the motor case, and the column is securely fastened to the floor through a rigid floor plate. E. B. Latham & Company, Broadway and

Murray street, New York city, are the general sales agents for these fans.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, ST. LOUIS, MO.

The Emerson company's fans are so well known as to need but little further

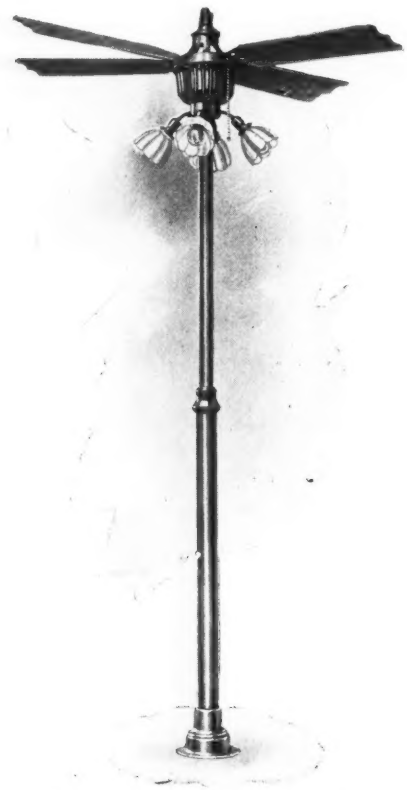


FIG. 28.—"TUERK" COLUMN FAN.

description. The 1906 types of Emerson desk fans are equipped with an entirely new form of base, which permits any desk fan to be readily converted into a sub-

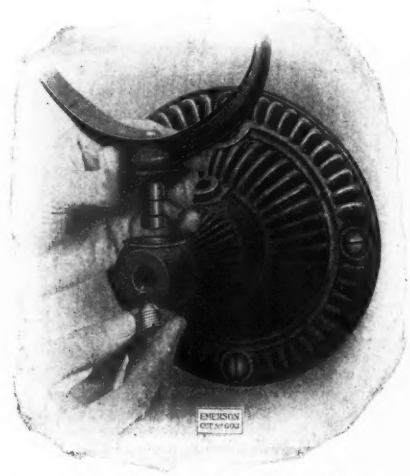


FIG. 29.—EMERSON ADJUSTABLE BASE.

stantial and attractive bracket fan. Fig. 29 shows the Emerson convertible base. A screw-driver is the only tool required. A brass set-screw in the rear of the base of the desk fan is removed and the motor, fan, guard and trunnion may be lifted off the standard high base and a stud in the trunnion inserted in the hole formerly occupied by the screw. By then inserting the set-screw in the hole from which the

FIG. 30.—"ECLIPSE" SOCKET FAN.

trunnion stud was removed, the joint is locked in its new position, as the projection at the point of the screw fits into the recess in the stud.

THE FIDELITY ELECTRIC COMPANY, LANCASTER, PA.

The Fidelity Electric Company is again calling attention to its alternating-current, eight-inch-blade, socket fan motor. The consumption of this fan is fifteen watts at a speed of 1,800 revolutions per minute. It may be screwed into an ordinary lamp socket without any additional plug or cord. The body of the motor is made of aluminum and the trimmings are nickel finished. The total weight of the fan is twenty-four ounces. This fan is shown in Fig. 30. Fig. 31 shows the type "L,"

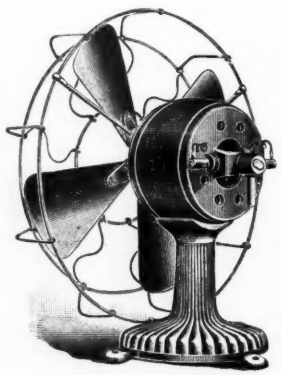


FIG. 31.—"ECLIPSE" DESK FAN.

direct-current, twelve-inch desk fan. The motor is of cast iron and the field magnet is in one piece. The field coils are form-wound and the armature is of the slotted drum type. The bearings are held in place by two long screws, and are centered by means of dowels. In the sixteen-inch size the body of the motor is of cast steel. Fig. 32 shows the revolving desk fan. The motor, carrying the guard and blade, is mounted upon a ball bearing at the top of

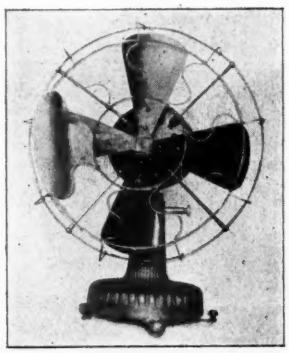


FIG. 32.—REVOLVING DESK FAN.

the pedestal, and is caused to revolve about its vertical axis by the reaction of the air blast from the deflector mounted in a permanent position on the guard. Connections are made between the motor and base by means of two small collector rings in the pedestal.

D. L. BATES & BROTHER COMPANY, DAYTON, OHIO.

This company is directing attention to its style "E" fan for direct currents. This fan is furnished in black enamel, nickel, oxidized copper or polished brass finish. The commutators are constructed of hard-drawn copper rods, compactly assembled under hydraulic pressure, insulated with pure India mica. The armature is large and well ventilated and of the slotted type. The field has six poles, and the field coils are form-wound, slipped over the

FIG. 33.—BATES STYLE "E" DIRECT-CURRENT CEILING FAN.

poles and wedged in position. The bearings are anti-frictional and interchangeable, the lower bearing being self-adjusting by the weight of the armature. The brushes are carbon, round in shape, and protrude through openings in the lower motor cover, so that renewal may be easily made.

FORT WAYNE ELECTRIC WORKS, FORT WAYNE, IND.

The line of fan motors manufactured by the Fort Wayne Electric Works last year, consisting of four types—desk, suspended revolving, bracket and telephone-booth fans—were all eight-inch, four-blade fans. This line has been added to by a 1906 model designated as the "Universal" bracket type, and also increased by the addition of a new line of ten-inch, four-blade fans in the desk, "Dragon" bracket and "Universal" types.

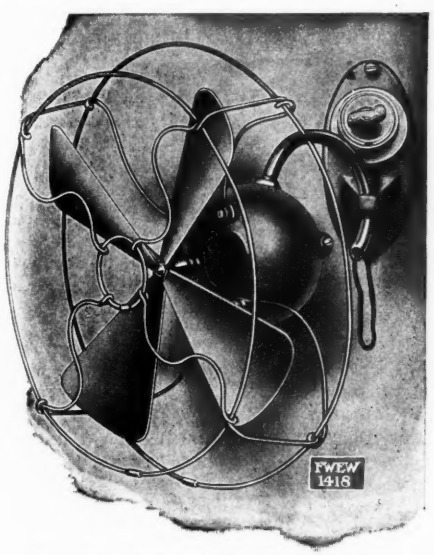


FIG. 34.—FORT WAYNE TEN-INCH "UNIVERSAL."

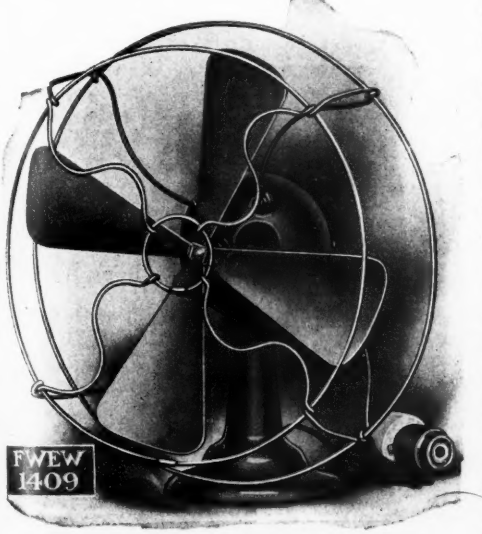


FIG. 35.—FORT WAYNE TEN-INCH DESK FAN.

The new "Universal" bracket type is similar to the "Dragon" bracket fan motor, but is more flexible owing to the different method of support. The wall bracket on this fan motor is of a neat oval design, having on its face a supporting lug and also a place for a switch. A circular goose-neck made of brass tubing is rigidly attached to the motor proper, this goose-neck working freely in a bracket plug, allowing for fan adjustment. The same general construction has been followed in the new line of motors as in the old. Both direct and alternating-current motors have a spherical contour. Fig. 34 shows the new 1906 ten-inch "Universal" bracket fan motor. The field magnet is built up of stamped laminations, and the field coils are shellacked, baked and taped. The armature is of the familiar drum type.

Fig. 35 shows the ten-inch desk fan motor. The direct-current motors require seventeen watts; the low-frequency, alternating-current motors twenty watts, and the high-frequency motors forty watts. The telephone-booth type has a speed of 1,200 revolutions per minute. The ten-inch motors run at a speed of 1,700 revolutions per minute and take approximately thirty-two watts.

The American Instrument Company.

The American Instrument Company has been formed for the manufacture of electrical measuring instruments. The company has equipped a factory at Newark, N. J., with its business and sales offices at 1114 Chestnut street, Philadelphia, Pa. The officers of the company are James G. Biddle, president; William Biddle, Jr., secretary and treasurer, and A. O. Benecke, chief engineer. James G. Biddle is general sales agent.

The Messrs. Biddle have for many years been prominently identified with the sale of electrical instruments, and Mr. Benecke has had a long connection with one of the large companies in the practical and scientific work of instrument design and construction.

The accompanying illustration shows the switchboard type of one of the new instruments which this company is placing on the market. This instrument is of the movable coil, permanent magnet type. The maker has given special care to the pivoting of the movable coils, and also to the dustproof features of the instrument cases. These defects, the company claims, are responsible for most of the troubles encountered in actual switchboard service with movable coil instruments. The movable coils in these instruments are mounted in such a manner that if they are free from friction when new they will remain so always. This is accomplished by using highly polished cylindrical steel pivots journaled in the best grade of watch jewels. The mechanical difficulties to be overcome in producing an instrument in this way are undoubtedly great, but when once accomplished an instrument of this kind, it is stated, will remain practically frictionless for many years.

The cases of the switchboard instruments are designed so that ample surface is provided where detachable parts are joined, and, in consequence, the company guarantees its cases to be perfectly dustproof. In this way the vital parts of each instrument are protected efficiently from any accumulation of dirt.

The permanent magnets are made of the best magnet steel obtainable, hardened and aged in accordance with the most improved methods.

The movable systems combine lightness with extreme stiffness, and with the method of pivoting it is impossible for the moving coil to come in contact with the pole-pieces or the core of the magnetic system.

By a selection of a proper winding for the movable coils the instruments are given a somewhat larger torque, permitting the use of stronger controlling springs. Zero errors are completely avoided.

The energy consumption of these instruments is low, under no circumstances being found objectionable from any standpoint.

SWITCHBOARD TYPE, VOLTMETER.

The series resistance in the voltmeters is wound non-conductive, and all voltmeters have a negligible temperature coefficient. In the ammeters the combination of instrument and shunt is also compensated over a large, and for all practical purposes sufficient, range of temperature. Voltmeters are adjusted to a uniform resistance per volt, and multipliers can be interchanged. Ammeter shunts are adjusted to the same drop of potential and are also interchangeable. The shunts are constructed to dissipate the heat generated in a satisfactory way, and will not overheat when run continuously under full load.

The scale opening in the front of the case is very large, and ample light is admitted to the scale, so that it can be read very clearly.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

YUCATAN ELECTRIC LIGHT PLANT SOLD—The electric light and power plant of Merida, Yucatan, owned by the firm of Siemens & Halske, has been sold to the American Gas Company for the sum of $1,600,000.

SHASTA ELECTRIC COMPANY INCORPORATED—Articles of incorporation of the Shasta Electric Company have been filed. The company is formed for the purpose of acquiring real estate, water rights and mining claims, and for the purpose of developing and selling electric power. The principal place of business is San Jose, Cal., and the capital is $1,000,000 of which $3,000 has been subscribed. The incorporators are C. W. Fancher, R. C. Wilson and W. E. Wretman.

STREET CAR CROWDING DECISION IN CHICAGO—Judge Mack, in the Circuit Court, Chicago, Ill., has handed down a decision declaring the ordinance passed last October, providing for a penalty against the street car companies for the overcrowding of cars, null and void. Five hundred suits has already been commenced by the city against the different street car corporations, and 2,000 more are pending. Judge Mack issued an injunction restraining the city from prosecuting the suits.

COLUMBUS POWER COMPANY FILES BIG MORTGAGE—The Columbus (Ga.) Power Company has filed a mortgage for $4,000,000 to the Commonwealth Trust Company, of Boston, Mass., to secure an issue of five per cent gold bonds. The mortgage covers all the property the company now owns or may acquire. The bonds will not all be issued at once, but $1,125,000 will be issued immediately and the proceeds used in carrying out the company's plans for a gigantic development of water power along the Chattahoochee river north of Columbus.

EXTENSIVE TROLLEY MERGER—A continuous interurban electric line from Green Bay, Wis., to Cincinnati, Ohio, is being projected by the Chicago & Milwaukee Electric Company. The plans are to merge all lines already built into a direct route, and to construct connecting lines. The merger of traction lines beyond Indiana is already complete. A line from Chicago to Kenosha, Wis., will be started at once, and extend to Milwaukee to meet the northern lines from Fond du Lac to Green Bay. Through Chicago the line will be elevated, and extend to Evanston.

CONTRACT LET FOR TROLLEY LINE BETWEEN LOCKPORT AND ROCHESTER, N. Y.—The Buffalo, Lockport & Rochester Railway has let a $2,000,000 contract to the Transit Construction Company, of New York, to build a double-track trolley line between Lockport and Rochester *via* the canal villages, the line to be completed this year. When completed the line will be turned over to the Toronto-Niagara Development Company, which will then build a connecting line from Lockport to Niagara Falls *via* Sanborn. In Niagara Falls the line will connect with the Toronto & Niagara Railway.

BIRMINGHAM RAILWAY COMPANY TO BUILD NEW CAR LINES—Stockholders of the Birmingham Railway, Light and Power Company have ratified the action of the directors in the matter of the increase of $1,000,000 in the capital stock. The latter now stands at $7,000,000. This new issue will be in the preferred shares. Franchises have been obtained at Tuscaloosa for the operation of electric railways and light plants, and it is supposed that the Birmingham Railway, Light and Power Company contemplates operations in that city, and also the installation of a railroad between Birmingham and Tuscaloosa.

THE ATLANTIC TELEPHONE COMPANY—According to an agreement reached between the Board of Estimate and Apportionment, of New York city, and the Atlantic Telephone Company, the company, in order to secure a franchise, is to pay the city $200,000 in cash for the franchise, and $2,000,000 in pro rata yearly payments for twenty-five years of the life of the franchise. The company is also to maintain a complete interborough telephone service free for all the departments of the city, and to furnish public telephone service to all parts of the city at five cents a call, and to supply house and office service at seventy-five per cent of the cost of the present service.

GUANAJUATO POWER COMPANY EXTENDING—The Guanajuato Electric Light and Power Company, the American concern which has a hydroelectric plant at el Duero, state of Michoacan, and furnishes electric current to Guanajuato, Leon, Irapuato and le Barca, will extend its service to include the towns of Ocatlan and Jamay, and also Ribera Castellanos, a new resort on lake Chapala. The transmission line is being built. The Lake Chapala Agricultural and Improvement Company, which owns Ribera Castellanos, has made arrangements to distribute current along the lake front and to use it in operating irrigation pumps, as well as in lighting cottages and other buildings.

INTERURBAN LINES IN SOUTHEASTERN KANSAS—The outlook is very encouraging for the construction of an extensive system of interurban lines in southeastern Kansas, which will include Chanute, Erie, St. Paul, South Mound, Parsons, McCune, Mineral, Scammon, Columbus, Galena, Earlton, Thayer, Cherryville, Independence and Coffeyville, with later an extension to Webb City and Carthage. The name of the company will be the Southeastern Kansas Railway, Light and Power Company. It is incorporated for $4,000,000, and the incorporators are L. Rosenthal, J. J. Jones, Frank Dixon and R. C. Rawlings, of Chanute, Kan., and J. W. Stephens, of New Orleans, La. The system has already been financed, $4,250,000 of construction bonds having been sold.

ELECTRIC DEAL IN NORFOLK, VA.—Arrangements are understood to have been completed for the formation of a new company to take over all the street railways and electric light plants in Norfolk, Va., and vicinity, including Portsmouth and Berkeley. The plans provide for raising $2,000,000 additional capital for extensive improvements which the companies in that section will have to make in order to meet the demands incident to the approaching Jamestown (Va.) exposition, to be held in Norfolk from May to November next year. A complete new power station of 15,000 horse-power capacity will be erected at a cost of $1,000,000, and the remainder of the money will be spent for extensions of the track into new territory, the purchase of new cars and barns, and the bringing of the system up to date. The name of the new company will probably be the Norfolk & Portsmouth Traction Company, and it will operate about 112 miles of electric railway.

OBITUARY NOTICES.

MR. JOHN B. EMBICK, New York city, manager for Wendell & MacDuffie, died recently at St. Luke's Hospital, New York city. Mr. Embick was born in Williamsport, Pa., in 1868, and graduated from Harvard College. He was a lawyer for several years in his native town, but gave up practice six years ago to take a position with the firm with whom he was employed at the time of his death.

MR. CARL HEINRICH VON SIEMENS, chairman of the firm of Siemens Brothers, and head of the firm of Siemens & Halske, died at Mentone, France, on Friday, March 23. For the greater part of his life he cooperated with his brothers, Ernst, Werner, William and Friedrich, and with the first-named two he was instrumental in the development of the firms of Siemens & Halske and Siemens Brothers. Fifty years ago he laid the network of telegraph lines which covers Russia, and which was maintained by his firm for twelve years, during which time he had charge of the factory established in St. Petersburg. In 1869 he went to London to take charge of the English branch of the business. He was personally concerned in the laying of the direct United States cable, the first cable across the Atlantic, for which his firm was the contractor, and also in the picking up from the ship Faraday of the broken end of the first cable. He was born at Menzendorf in Mecklenburg in 1829, and was the sixth son in a family of eleven sons and three daughters.

PERSONAL MENTION.

MR. WILLIAM S. BARSTOW, the well-known consulting engineer, of New York city, and president of the New York Electrical Society, has returned from a trip of some two months through the northwest.

MR. WILLIAM S. HINE has again entered the electrical field, becoming associated with the Fort Wayne Electric works, Fort Wayne, Ind. For some time Mr. Hine was connected with the Stanley interests and also with the Western Electric Company.

MR. ALBERT SCHEIBLE, whose work during the past sixteen years is well known to the users of the George Cutter Company's specialties, has resigned as secretary and treasurer of this company. Mr. Scheible has returned to Chicago, Ill., and it is understood that he is to head a new manufacturing company.

GENERAL EUGENE GRIFFIN, first vice-president of the General Electric Company, sailed from New York on April 10 on the steamer Graf Waldersee. General Griffin plans an extended trip in England and on the Continent largely for rest and recreation. As he is a director in the Cie Francaise Thomson-Houston and vice-chairman of the British Thomson-Houston Company, these interests will naturally claim a portion of his time.

MR. GEORGE W. KITTREDGE has been appointed chief engineer of the New York Central & Hudson River Railroad. Mr. Kittredge will be chief engineer not only of the New York Central proper, including all the subsidiary lines east of Buffalo, but also of the West Shore railroad. Mr. Kittredge is now chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway. He was graduated from the Massachusetts Institute of Technology in 1877 and entered the railway service in 1880 as an employé in the maintenance of way department of the Pittsburg, Cincinnati & St. Louis Railway, and until 1890 was connected with the Pennsylvania Railroad lines west of Pittsburg. In 1890, and until July 1, 1901, he was engineer of maintenance of way and assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway. On July 1, 1901, he was appointed chief engineer of the same road. He is a member of the American Society of Civil Engineers, and was president of the American Railway Engineering and Maintenance of Way Association in 1902 and 1903.

MR. JOHN C. BRACKENRIDGE has been appointed consulting engineer of the New York Central & Hudson River Railroad. Mr. Brackenridge is well known in the traction field through his connection with the Brooklyn Rapid Transit Company, first as chief engineer and later as general manager. His association with the Brooklyn Rapid Transit Company extended over a period of ten years, during which all of the more recent power stations of the company were built, the greater part of the elevated system electrified and the operation of the cars extended over the present Brooklyn Bridge, all of which was accomplished under his immediate supervision. Mr. Brackenridge resigned from the Brooklyn Rapid Transit Company two years ago to accept the position of commissioner of public works of Brooklyn, under Borough President Littleton. He occupied this position until the first of the current year. Mr. Brackenridge has served on almost all the public commissions of engineering experts appointed in recent years by the city. His business with the New York Central will have to do with those divisions which are to be electrified. Mr. Brackenridge is president of Rossiter, MacGovern & Company, New York city, who early in the year largely increased their capital stock to enter the engineering and contracting field as engineers and contractors for all classes of work, making a specialty of engineering and contracting for steam and electric railways and electric power-plants.

MR. JOHN C. BRACKENRIDGE.

ELECTRICAL SECURITIES.

That the natural tendency of the stock market was still upward, was clearly demonstrated last week, the rising influences being checked somewhat by monetary considerations and the labor situation in the coal fields. While this slight check upon activity is acknowledged, it is everywhere conceded that the open winter has made possible the carrying forward of construction in every part of the country. Developments everywhere present an encouraging face and it is freely predicted that the spring trade will overbalance in prosperity any that have been witnessed in some time.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 7.

New York:	*Closing.*
Allis-Chalmers common	21⅝
Allis-Chalmers preferred	56½
Brooklyn Rapid Transit	86⅜
Consolidated Gas	142
General Electric	172
Interborough Rapid Transit	230
Kings County Electric	175
Mackay Companies (Postal Telegraph and Cables) common	61¾
Mackay Companies (Postal Telegraph and Cables) preferred	73¼
Manhattan Elevated	155
Metropolitan Street Railway	117
New York & New Jersey Telephone	155
Western Union	92
Westinghouse Manufacturing Company	156
Boston:	*Closing.*
American Telephone and Telegraph	138½
Edison Electric Illuminating	248
Massachusetts Electric	67½
New England Telephone	141
Western Telephone and Telegraph preferred	89

The Edison Electric Illuminating Company declared a regular quarterly dividend of 2½ per cent, payable May 1 to stockholders of record April 10.

The New England Telephone and Telegraph Company has filed with the Massachusetts secretary of state a statement of its financial condition as of December 31, 1905. This shows total assets of $34,549,627, and liabilities of $32,786,750, leaving a surplus of $1,762,877, as compared with $1,597,403 for the previous year.

Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	28¾
United Gas Improvement	94
Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	158
Metropolitan Elevated preferred	68
National Carbon common	91
National Carbon preferred	119
Union Traction common	7
Union Traction preferred	21

The South Side Elevated daily average for March was 95,466, an increase of 4,082.

The Oak Park elevated traffic average for March, including transfers, was 49,542, an increase of 1,375.

The Chicago Telephone Company's gain in telephones for March was 2,137. The total now in use is 150,184.

The Chicago Edison and Commonwealth Electric companies will spend in their business the current fiscal year beginning April 1, $4,500,000 from funds raised by sale of Edison stock and Commonwealth bonds. The increase of $1,774,858 in Edison stock is payable in four quarterly instalments, beginning May 1. The $3,750,000 new Commonwealth bonds will bear 5 per cent.

The income account of Metropolitan West Side elevated railroad for the year ended February 28 is as follows: Gross, $2,452,327; expenses, $1,172,430; net, $1,279,897; charges, $957,266; surplus, $322,631; previous surplus, $468,382, making a total of $791,013, as compared with $468,382 for the previous year. The daily average of passengers was 114,232, an increase of 12,308. The company has paid $200,000 on its floating debt, reducing it to $600,000. Moses J. Wentworth and Nathan Allen have been elected directors succeeding George Higginson, Jr., and John P. Wilson. The directors have reelected the retiring officers.

ELECTRIC LIGHTING.

BEVERLY, MASS.—Peabody has appropriated $9,000 for the electric light plant.

CHILHOWIE, VA.—F. P. McCready has installed an electric light plant at Chilhowie.

HOMER, N. Y.—Cazenovia will install electric lights. The new system will cost $2,500 for all-night service.

RUGBY, N. D.—The citizens of Enderlin have organized a stock company and will erect an electric light plant the coming summer.

ESSEX JUNCTION, VT.—The People's Light and Power Company, Essex Junction, Vt., is contemplating the installation of a 400-kilowatt water-wheel-driven unit.

NEW BRUNSWICK, N. J.—The borough council of Highland Park has signed a contract with the Public Service Corporation for the lighting of the streets of the borough.

CANNELTON, IND.—The Cannelton city council and the electric light board have concluded to rebuild the electric light building recently destroyed by fire. The expenditure calls for $2,500.

SHAW, MISS.—At a meeting of the Shaw board of aldermen, a contract was let to Sanders-Johnson Company, of Vicksburg, for the erection of an electric light and water plant for the sum of $24,593.

SPOKANE, WASH.—George Donald, president of the Yakima National Bank, announces that he and his associates will build a $200,000 water and light plant. Power will be secured from the Nachez river.

CHAMBERSBURG, PA.—The Waynesboro council has entered into another five-year contract with the Waynesboro Electric Light and Power Company to furnish street lighting for the town, at a cost of $92.50 a year for each arc light.

SAN BERNARDINO, CAL.—The Ontario Power Company has let a contract to the Pacific Coast Manufacturing Company for a 150-horse-power plant to be constructed at Upland, at a cost of $23,950. This cost does not include the building.

COTTAGE GROVE, ORE.—The electric light plant owned by H. O. Thompson has been sold to the Willamette Valley Traction Company. The purchase price was $14,000. The system has recently been overhauled, and is considered one of the best small plants in the state.

WILKESBARRE, PA.—The dam in the Susquehanna river at Nanticoke, owned by the Pennsylvania Railroad, has been sold to the Nanticoke Electric Power Company for $30,000. The dam was built fifty years ago to supply water for the old Pennsylvania canal, now abandoned.

SALT LAKE CITY, UTAH—E. T. Merritt purposes establishing an electric plant at Green river. He has filed an application with the state engineer for 1,000 second feet of water from the Green river, in Emery county. Sixteen fifty-seven-inch turbines will be used, giving 13,000 horse-power.

ELKTON, MD.—The town council of Elkton has signed a three-year contract with the Elkton Electric Light Company to light the town at $1,000 less than has been paid to a local light company. Arc lights are given for $60 per light, while twenty-five-candle-power incandescents are furnished at $4.25 per light per year.

NORTH YAKIMA, WASH.—An appropriation of 10,000 cubic feet of water from the Yakima river has been made by Robert H. Hunter and George Weigle, representing eastern capitalists. The plant contemplated will have sufficient capacity to supply power for the entire valley. It is not definitely known when the work will commence.

SPOKANE, WASH.—The Lewiston-Clarkston Company is laying its new pipe line from Asotin creek to Vineland. The company plans the development of 6,000 horse-power at the Grand Round river, thirty miles south of Lewiston. E. A. Libby, the president, says there will be an electric car line between Lewiston and Clarkston in the near future.

SPOKANE, WASH.—Jay P. Graves, of Spokane, has purchased from Frank P. Hogan the "Bowl and Pitcher" power site, seven miles down the Spokane river, paying $50,000 for it. The purchase includes the franchise in Spokane which was granted to the Spokane Light and Power Company, March, 1903. It is understood that Mr. Graves and associates will put in a light and power plant at a cost of $500,000.

MEDICAL LAKE, WASH.—The Washington Water Power Company has begun the erection of a large addition to its power station at Medical Lake. The addition will be as large as the present one. Heretofore the station at Medical Lake has been used only as a transforming station. New machinery will be installed at once.

NIAGARA FALLS, N. Y.—The Niagara Falls Electrical Transmission Company will soon erect a distributing station in Niagara Falls or the immediate vicinity. This corporation was recently given permission to increase its capital stock from $100,000 to $3,500,000, and the additional capital will be used in the extension of the transmission line and the erection of transformer stations.

PITTSBURG, PA.—The United Electric Company, of Wilmerding, a local organization, at its annual meeting held at Wilmerding, decided to increase its capital stock to $75,000, the original capital being $50,000. The increase is made necessary by the growing business of the company. The officers of the company are: Henry Harris, president; W. J. Hally, vice-president; B. F. Steddeford, secretary; Philip E. Geiss, treasurer.

NEWTOWN, PA.—The Newtown Electric Light Company at its annual meeting elected the following directors: A. W. Watson, George C. Worstall, T. S. Kenderdine, William M. Watson, George C. Blackfan, Robert Kenderdine, Edward H. Cuckman. The officers to serve the ensuing year are A. W. Watson, president; T. S. Kenderdine, vice-president; William M. Watson, secretary; Robert Kenderdine, treasurer.

PALMYRA, N. Y.—The Palmyra board of village trustees at a special meeting granted a franchise to the Palmyra Gas and Electric Company. This company has been furnishing both gas and electricity to the village for the past year. The franchise calls for an all-night service after October 1 next. The Palmyra Gas and Electric Company is owned by the Morris syndicate, with headquarters at Penn Yan.

GREENVILLE, S. C.—The officials of the Southern Power Company will shortly be ready to guarantee the delivery of power from the development at Great Falls, S. C., by January 1, 1907. The transmission lines will be stretched up the river to the Catawba plant, near Rock Hill, S. C., and from that point the current will be distributed to Gastonia, Mount Holly, Fort Mill, Rock Hill, Charlotte and other adjacent points.

DURANGO, COL.—The Animas Power Company has decided to spend $650,000 in improvements to the plant and in increasing the water power. A large portion of this money will be spent in bringing the water from Lime creek to the main storage reservoir. This company has already spent nearly $2,000,000 and has the machinery in place. The decision to spend an additional $650,000 is made because the company has already received orders for power that will tax the capacity of the present plant.

TEMPLETON, MASS.—The committee appointed to investigate the electric lighting proposition for the town reported unanimously to the town meeting in favor of establishing a municipal lighting plant, the town to obtain its power from the Gardner Electric Light Company, do its own wiring and to sell power to citizens for commercial use at twelve and one-half or fifteen cents per kilowatt-hour, thereby materially reducing the cost of lighting the streets of the town. This recommendation was adopted by a vote of 270 to 35.

ALBANY, N. Y.—The application of the village of Lake Placid for consent to build, maintain and operate an electric plant for the purpose of supplying lights to the village and its inhabitants has been granted by the state gas commission. The application of the Paul Smith's Electric Light and Power Company for consent to transact business in various towns and villages of Essex county was granted, except as to the town of North Elba and the village of Placid, the company not having obtained the requisite consent of the proper municipal authorities of North Elba, and Lake Placid being provided for by the order of the commission in its case. The Paul Smith's company is allowed to issue capital stock to the amount of $75,000. The amount applied for was $100,000.

ELECTRIC RAILWAYS.

CANTON, OHIO—The work of building the Sandy Valley Traction Company line from Alliance south to New Philadelphia will begin within two months.

ROANOKE, VA.—It is reported that the Roanoke Railway and Electric Company contemplates expending $150,000 in improvements to its plant during the ensuing year.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company has accepted the route for the new Como-Hamline line proposed by the city council. It is expected that the line will be completed by July 1.

COOPERSTOWN, N. Y.—The Oneonta, Cooperstown & Richfield Springs Railroad has been sold at public auction for $960,000 to Henry W. Bean, chairman of the reorganization committee of the bondholders.

WALLA WALLA, WASH.—Isaac W. Anderson, president of the Walla Walla Traction Company, has announced that work on seventeen miles of street railway and interurban line, connecting Walla Walla with Milton, will be commenced at once.

HUTCHINSON, KAN.—Contracts have been let by the Hutchinson Interurban Railway Company for the machinery to be used for the new electric street railway and light plant. The machinery is to be ready in ninety days, and the car line will be in operation before August 1.

HUBBARD CITY, TEX.—The Hubbard city council has granted to the St. Louis Southwestern Railway Company a franchise to occupy streets and alleys of the city for the purpose of constructing switch tracks to the plants of the Union Central Light and Ice Company, of Hubbard City.

SCRANTON, PA.—The Scranton Railway Company has recently ordered for its cars thirty complete straight air-brake equipments of the type manufactured by the General Electric Company. The new equipments include air compressors, governors, motormen's valves, brake cylinders, reservoir, etc.

BARTLETT, ILL.—The Chicago & Oak Park Elevated Railway Company, of Chicago, through Clarence A. Knight, general counsel, has submitted plans to the promoters of the proposed new electric line between Elgin and Chicago, for a Lake Geneva branch, which will pass through Desplaines, Palatine and Lake Zurich.

WABASH, IND.—James Lynn, of Chicago, states that he has interested capital to complete the Wabash & Rochester interurban line, for which a subscription of $95,000 was voted here five years ago. Eighteen miles of the roadbed are graveled and ready for the rails. He states that active construction work will commence in thirty days.

LA CROSSE, WIS.—It is announced that the La Crosse & Black River Falls electric road will be built this summer. The president, Mills Tourtellotte, who is in New York, has completed final arrangements. The road will run from La Crosse to Neillsville, and may go on to Superior. It will enter La Crosse from Onalaska over the St. Paul tracks.

BOISE, IDA.—The Caldwell Interurban Railway Company has completed its organization by the election of Walter R. Seebree, president; Montie B. Gwinn, vice-president; A. K. Steunenberg, secretary and treasurer. The president was instructed to advertise for bids for the seven miles of grading from Caldwell to the Deer Flat reservoir.

ALLIANCE, OHIO—Promoters of the Sandy Valley Traction Company state that work will be started on the line from Alliance to New Philadelphia within two months. The towns touched are Homeworth, Moultrie, Minerva, Pekin, Oneida, Malvern, Waynesburg, Magnolia, Sandy Valley and Secor. The main line is fifty miles long.

HARTFORD, CT.—The Consolidated Street Railway Company, of Connecticut, has acquired the controlling interest in the Hoosack Valley Street Railway Company, of North Adams, which is twenty-eight miles long and runs from Cheshire to North Adams and thence to Williamstown and the Vermont line. The purchasing company is controlled by the New York, New Haven & Hartford Railroad.

FORT WAYNE, IND.—At the annual meeting of the Fort Wayne & Wabash Valley Interurban Road officers were reelected as follows: president, J. Levering Jones, of Philadelphia; first vice-president, Charles Murdock, of Lafayette; second vice-president, W. Kesley Schoepf, of Cincinnati; secretary, S. B. Fleming; assistant secretary, Henry Rainey, of Philadelphia. The report of the company showed a gratifying increase in revenues and a successful year of operation.

HAMPTON, VA.—The Hampton & Yorktown Railway Company, which proposes to build a street railway from Hampton to Yorktown, has been formally organized. Frank W. Darling is president; Nelson S. Groome, vice-president, and Charles H. Hewins, secretary and treasurer. The company is capitalized at $300,000. The work of surveying the proposed route has already been accomplished, and it is stated that actual work on the construction will begin within a short time.

DECATUR, ILL.—At a meeting of superintendents of the various properties of the McKinley syndicate, it was announced that interurban lines were to be built this year as follows: Clinton to Bloomington, Springfield to Jacksonville, Springfield to Lincoln. The line from Decatur to Champaign depends on franchises now pending for entrance to the two cities mentioned. Five million dollars, it was stated, had been applied for building interurbans in Illinois this year.

CHATTANOOGA, TENN.—The properties of the Chattanooga Electric and Rapid Transit Company have been purchased by Graham & Company, bankers of Philadelphia, representing New York, Boston, Baltimore and Philadelphia capitalists, and the sum of $500,000 has been deposited with a trust company to be used for improvements. The name of the new organization will be the Chattanooga Railways Company, and application will be made at once for a charter of incorporation.

BLUEFIELD, W. VA.—The Bluefield & Hinton Electric Railway and the East River Electric Company, operating under a West Virginia charter, have recently consolidated and reincorporated in Virginia as the Bluestone Traction Company, with authority to build and equip trolley roads and furnish power and light within Tazewell county, Va., and Mercer and McDowell counties, W. Va. The company expects to construct about twenty miles of line within the next twelve months. Mr. P. W. Wallizer, of Bluefield, W. Va., is general manager.

NORWALK, OHIO—An important link in the lines operated by the Lake Shore Electric will be built this summer by the Sandusky, Fremont & Southern Railway Company, incorporated at Columbus with $10,000 capital. The company will build a line from Sandusky to Fremont, connecting with the main line of the Lake Shore Electric which runs through Norwalk. This will enable the road to run its cars over two routes similar to the two routes operated by the Lake Shore & Michigan Southern Railway. With this link completed the Lake Shore Electric will be able to handle business between Toledo and Sandusky direct.

NEW YORK, N. Y.—Plans have been filed for the enlargement of the power-station and car house of the New York City Street Railway Company on the block from One Hundred and Twenty-eighth to One Hundred and Twenty-ninth streets, on Amsterdam avenue, which was the first street-car cable power-house erected in New York city. Two stories are to be added to the building, making it a three-story and basement edifice, and the interior will be remodeled generally. The improvements are to cost $150,000. Plans were also filed for new offices in the office building of the same company, on Sixth avenue from Fiftieth to Fifty-first street.

BOSTON, MASS.—The Old Colony Street Railway Company, operating roads in the district south of Boston, is about to increase materially its rolling stock. Forty-one additional car equipments have been ordered for this purpose from the General Electric Company, of Schenectady, N. Y. These will consist of quadruple General Electric 90 (fifty-horse-power) direct-current motors, equipped with the Sprague-General Electric type M multiple unit control for operating the cars either singly or in trains. The new cars are to be provided with General Electric straight-air-brake apparatus. For the present the Old Colony company will operate cars singly, but with the view of later operating two and three-car trains, these cars are being equipped with multiple-unit control. The railroad commissioners have given the Old Colony Street Railway system authority to carry freight and express matter over its lines between Boston and Fall River.

INDUSTRIAL ITEMS.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has ready its catalogue of machinery and tools for 1906.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published a very attractive booklet dealing with electric lighting in the department store.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in bulletin No. 75 describes the various applications of single-phase, constant-speed, alternating-current motors.

THE GARVIN MACHINE COMPANY, New York city, has ready for distribution a new catalogue which completely illustrates and describes its line of machine tools of every description. This catalogue may be secured upon request.

W. N. MATTHEWS & BROTHER, 219 North Second street, St. Louis, Mo., have published a handsome catalogue descriptive of Stombaugh guy anchors and the Kearney cable clamp. These devices are described carefully, and the illustrations are well worked out.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 147 describes and illustrates the inductor alternator. This bulletin contains some very interesting and practical information, and should be secured by anyone interested in this subject.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., will be pleased to send its calendar card for April, May and June to any one interested upon request. The calendar card just issued has an illustration of the Crocker-Wheeler core-type transformers. Transformer bulletin No. 65 gives full information.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., is distributing a circular illustrating and describing the Roller direct-reading bond tester manufactured by the Whitney Electrical Instrument Company. Catalogue No. 80, covering a full line of overhead material, rail bonds, construction material, track and line tools, will be forwarded upon request.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, announces that at the recent annual meeting the office of general manager, which had been vacant since the death last June of Mr. Charles H. Wellman, was filled by the election of Mr. S. H. Pitkin, whose present title will be first vice-president and general manager. Otherwise no changes were made in the officers of the company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., will be pleased to send bulletin No. 1039, descriptive of the electrical equipment of a modern shipyard, to anyone interested upon request. This is a study of the electrical power distribution and application in the shipbuilding plant of the Fore River Ship and Engine Company, Quincy, Mass., reprinted from the ELECTRICAL REVIEW, April 26, 1902.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports closing a contract with the Kinloch Long-Distance Telephone Company, St. Louis, Mo., for 10,000 central-energy telephones. This is the first order the Kinloch company has placed for new telephones to be used in conjunction with the 17,000-line switchboard now being installed by the Stromberg-Carlson company.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., in circulars Nos. 24 and 25 calls attention to special features of the "Inter-Pole" motor. Circular No. 24 shows the difference between the old type and the "Inter-Pole" type, and gives some interesting data regarding sparkless commutation. Circular No. 25 describes the "Inter-Pole" motor as adapted for various forms of driving. These bulletins may be secured upon request from the company.

THE MOORE ELECTRICAL COMPANY, 52 Lawrence street, Newark, N. J., has published a booklet reproducing a number of typical installations of the Moore loop-tube system of lighting. The cost of operation of this system is stated to be less than that of an incandescent electric lamp system. The exact maintenance cost of an individual tube or lamp depends not only on its length, but also on the color of the light used, because the different gases or vapors vary in their spectra and also in their efficiencies. The intensity of the light can be regulated from a faint glow to twenty or more candle-power per foot.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., has issued a handsome circular entitled "Shoe Iron Problems." The highest awards on electric heating appliances at the World's Fair, St. Louis, Mo., 1904, were granted to the American Electrical Heater Company. This circular shows the adaptation of electric shoe irons, and in addition to the illustrations and the descriptive text contains reproductions of testimonials from satisfied users.

THE OSWEGO BOILER AND ENGINE COMPANY, Oswego, N. Y., announces the complete reequipping of the Oswego Boiler Works with machinery comprising complete hydraulic and air tools, flange presses, riveters and foundry and machine shop facilities. Mr. L. L. Bentley, mechanical engineer, recently mechanical engineer of the Lehigh Valley Railroad, is vice-president and general manager. The boiler shop is in charge of Mr. C. W. Crozier, who has had a large experience in all classes of boiler and plate work.

MR. W. E. G. MITCHELL, 88 Maiden Lane, New York city, is making a specialty of sealing cements for electrical purposes. Red "Selite" is for sealing switchboards, panels, cutouts, spark coils, transformers and other electrical specialties. Black "Selite" is for sealing dry batteries, pocket batteries, automobile batteries, etc. This cement has a high melting point, adheres perfectly, and is susceptible of a bright finish. In addition to these standard insulating compounds Mr. Mitchell is prepared to make up insulating compounds for special work.

THE TEA TRAY COMPANY, Newark, N. J., notifies the trade that it has now arranged to manufacture, under United States patent No. 416,682, to Lawrence, half shades generally known as the A. A. McCreary half shades. This patent has recently been in court on a suit for infringement, and has been upheld and an injunction issued against the infringer. Any further infringement of the patent by others will be promptly followed by injunction. The Tea Tray Company is ready to receive orders and supply these half shades to the trade. The company announces that all business will receive very careful attention.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, Keystone Building, Pittsburg, Pa., will be pleased to send its price list of American enameled steel conduit couplings and elbows upon request. This conduit is furnished in tubes of ten-foot lengths, threaded at each end with coupling. The American conduit is a heavy wall steel tube enameled both inside and outside. The tube is made of mild steel, manufactured especially to meet conduit requirements, and may be bent to short radii without breaking. The steel, being soft, is easily cut or threaded. The enamel remains tough and elastic under great extremes of temperature.

THE BALL ENGINE COMPANY, Erie, Pa., announces a number of sales, among which may be mentioned the following: Atlanta Steel Hub Company, Atlanta, Ga., one 150-horse-power, single-cylinder engine; Salt Lake Hardware Company, Salt Lake City, Utah, one 200-horse-power, single-cylinder engine; Union National Bank, Pittsburg, Pa., two 320-horse-power, tandem-compound engines, and one 150-horse-power, single-cylinder engine; Massachusetts Cotton Mills, Lowell, Mass., one 500-horse-power, single-cylinder engine; Pittsburg Plate Glass Company, Pittsburg, Pa., two 200-horse-power simple engines; Milwaukee Coke and Gas Company, Milwaukee, Wis., one 550-horse-power, single-cylinder engine; New River & Pocahontas Coal Company, Gentry, W. Va., two 750-horse-power, cross-compound engines.

THE POWER AND MINING MACHINERY COMPANY, Milwaukee, Wis., has recently completed the shipment of a No. 9 McCully rock and ore-breaker to the General Crushed Stone Company for its plant at Rock Hill, Pa. The Power and Mining Machinery Company is also building several other large machines for the General Crushed Stone Company. In order to better handle its rapidly increasing business from the Rocky mountain district, the Power and Mining Machinery Company has opened an office at 312 Seventeenth street, Denver, Col. This new office is in charge of Henry F. Jurs as district manager, who will give his personal attention to all enquiries coming from Colorado, Wyoming and New Mexico. The company has ready for distribution catalogue No. 4, descriptive of machinery for rock-crushing plants, which will be forwarded to any one interested, upon request.